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JOURNAL OF SCIENCE.

AUGUST, 1882.

I. OCCULTISM RECONSIDERED.*

(Concluded from page 409.)

IN what sense the Occultists pronounce the soul a "material reality" is not quite clearly shown. Mr. Sinnett writes, "Not material as chemistry understands matter, but as physical science *en bloc* might understand it if the tentaculæ of each branch of science were to grow more sensitive, and were to work more in harmony." The author here scarcely recognises the great and increasing harmony between physics and chemistry, which are becoming more and more difficult to distinguish from each other. We are naturally reminded of the speculations of Prof. Jäger which were discussed in the "Journal of Science" for 1880 (p. 298). With him, as with Mr. Sinnett, the spirit is a more subtle principle, the "soul of the soul." But the chief point to be noted is this—to the vast majority of educated Europeans in the present day man is essentially during life a unitary being, capable of perceiving and acting only where his body happens to be. This body he neither views as his "dwelling" nor as his "prison," but, for the present at least, as himself. The sole difference between the monist and the ordinary philosophically and theologically orthodox dualist is that, according to the former, personality and consciousness are finally extinguished at death, whilst the latter considers that the soul or the spirit, which he does not sharply diagnose, will survive the decomposition of the body. The

* The Occult World. By A. P. SINNETT. Second Edition. London: Trübner and Co.
Zanoni. By Lord E. BULWER LYTTON.
A Strange Story. By Lord E. BULWER LYTTON.

Occultist dissents from both. According to Mr. Sinnett—"The body is the prison of the soul for ordinary mortals. We can merely see what comes before its windows; we can take cognisance only of what is brought within its bars. But the adept has found the key of his prison, and can emerge from it at pleasure. In other words, the adept can project his soul out of his body to any place he pleases." Elsewhere we read—"While his body lives his soul is, so to speak, a captive balloon, though with a very long, elastic, and imponderable cable."

The practical differences resulting from these opposite views are immense. Thus to us gross stupid Westerns the very idea of asceticism appears absurd. The attempt to get more and better work out of our system by suppressing its natural functions, by fasting, dirtiness, inaction, and, as far as possible, by dispensing with respiration, seems as foolish as it would be to try to obtain more duty from a steam-engine by neglecting to supply it with fuel and to oil and clean it. But if the connection between soul and body be such as Mr. Sinnett alleges, it is conceivable—though certainly not proved—that what invigorates the one may debilitate the other, and inversely. We cannot help adding that both history and observation prove the general effects of asceticism to be distinctly degrading.

The doctrine of metempsychosis is plainly taught. Koot Hoomi speaks of "man's true position in the universe in relation to his previous and future births."

Spiritual beings other than human are referred to. Some are of a lower grade:—"Those semi-intelligent Forces whose means of communicating with us are not through spoken words, but through sounds and colours in correlations between the vibrations of the two. For sound, light, and colour are the main factors in forming those grades of intelligences, those beings of whose very existence you have no conception, nor are you allowed to believe in them,—Atheists and Christians, Materialists and Spiritualists, all bringing forward their respective arguments against such a belief,—Science objecting stronger than any of these to such a degrading superstition."

But there are more exalted beings, "the higher planetary spirits, the only spirits we believe in." These last words are significant.

A few pages further we read that humanity, "in this everlasting isolation and neglect, has evolved gods unto whom it ever cries for help, but is not heard." Again, and more decidedly, Koot Hoomi is made to say—"If we had the

powers of the imaginary personal God." We by no means wish to brand Occultism as one phase of Atheism, or to invoke against it the *odium theologicum*. But it strikes us as somewhat strange that rejectors of a personal God should yet call themselves "theosophists"!

A prominent point in the philosophy of the Brotherhood is that it dispenses with the notion of time, at least as commonly understood. Says Koot Hoomi:—"I feel even irritated at having to use these three clumsy words—Past, Present, and Future. Miserable concepts of the objective phases of the subjective whole, they are about as ill-adapted for the purpose as an axe for fine carving."

We come now to the most important point of all—the evidences. We find in the work before us most startling assertions; how are they to be verified? How are we to satisfy ourselves that certain recluses in the mountains of India and Thibet possess knowledge far beyond that of our most gifted investigators, and power which from our point of view must appear superhuman? We are far from asserting, or even from wishing to insinuate, that Koot Hoomi is a myth, or that Madame Blavatsky, Col. Olcott, and Mr. Sinnett are dupes or deceivers. But it cannot be forgotten that impostors—*e.g.*, Cagliostro—might make assertions quite as strong, and apparently sincere, and advance claims quite as lofty as any we find in the "Occult World." Where, then, are we to look for satisfaction? Occult Science does not appear to have ever aimed at industrial applications, or if it has they have been kept concealed, so that one class of evidences of necessity fails us. The only proofs here brought forward are certain "feats"—we take the word from Mr. Sinnett himself—said to have been performed. These feats as here described are certainly of the most remarkable, distinctly out of the power of Open Science to produce, and we think beyond the scope of the juggler. Thus a picnic was arranged, in the neighbourhood of Simla, at which Mr. and Mrs. Sinnett, Madame Blavatsky, and three other persons were to have been present. A seventh person joined them on setting out, after all the arrangements had been made and the baskets packed. Whilst breakfast was being prepared in the woods it was noticed that there was one cup and saucer too few, and some one laughingly asked Madame Blavatsky to create another cup and saucer. She replied that it would be very difficult, but that she would try. She as usual held mental conversation with the Brothers, and then wandered about within a radius of half-a-dozen to a dozen yards from the spot where the

party were sitting. "Then she marked a spot on the ground, and called to one of the gentlemen to bring a knife to dig with. The place chosen was the edge of a little slope, covered with thick weeds and grass and shrubby undergrowth. He—let us call him X—tore up these in the first place with some difficulty, as the roots were tough and closely interlaced. Cutting into the matted roots and earth with the knife, and pulling away the *débris* with his hands, he came at last on the edge of something white, which turned out, as it was completely excavated, to be the required cup. A corresponding saucer was also found after a little more digging. Both objects were in among the roots which spread everywhere through the ground, so that it seemed as if the roots were growing round them. The cup and saucer both corresponded exactly, as regards their pattern, with those that had been brought for the picnic. I may as well add that afterwards, when we got home, my wife questioned our principal khitmutgar as to how many cups and saucers of that particular kind we possessed. In the progress of years, as the set was old, some had been broken, but the man at once said that nine tea-cups were left. When collected and counted that number was found to be right, *without* reckoning the excavated cup. As regards the pattern it was one of a somewhat peculiar kind, bought a good many years previously in London, and which assuredly could never have been matched in Simla."

There are, we submit, only three conceivable ways of accounting for this occurrence. Either—

1. Mr. Sinnett is guilty of deliberate deception, or—
2. He and others present were themselves deceived by an elaborate fraud, or lastly—
3. The cup and saucer were produced in the earth where found by some agency to us inconceivable.

As regards the first alternative, though we have not the pleasure of knowing Mr. Sinnett personally, yet a friend of high scientific standing vouches both for his integrity and for his general acuteness and freedom from gullibility.

The second supposition literally bristles with difficulties. The ground where the cup was found is described as undisturbed. If a tunnel had been dug, through which the cup might have been thrust to the spot where it lay, some traces of such an excavation would have been found when a special search was made shortly after. What is equally important, the need for a cup and saucer could not have been foreseen, since it arose from an unexpected person joining the party at the last moment. Again, the servants, without the

knowledge of the guests, chose these particular cups, which were taken from amidst other sets. Besides, there are two roads from Simla to the final destination of the party. Neither Madame Blavatsky nor Col. Olcott had any share in the selection of the one actually taken, and had the other been chosen the party would never have picnicked at that particular spot. Hence, as the facts are presented, the second supposition seems inadmissible, and there remains only the third, startling as it admittedly is. It should be mentioned, as Mr. Sinnett candidly admits, that Mr. X, who dug up the cup, afterwards changed his opinion as to the satisfactory character of the occurrence, and argued that the cup and saucer might have been thrust into their places by means of a tunnel cut from a lower part of the bank.

A variety of other feats are recorded, for which we must refer to Mr. Sinnett's book. The Brothers were further petitioned to give some demonstration of their powers which should be utterly incontrovertible, such as to produce in India a copy of the London "Times" of that day's date. Koot Hoomi, however, pronounced this test inadmissible, precisely because it would close the mouths of the sceptics. Says he—"What are they to expect who would offer the world an innovation which, owing to human ignorance, if believed in will surely be attributed to those dark agencies that two-thirds of humanity believe in and dread as yet. . . . What, then, would be the result of the most astounding phenomena supposing we consented to have them produced? However successful, danger would be growing proportionately with success. Test after test would be required, and would have to be furnished. Your daily remark is that one cannot be expected to believe unless he becomes an eye-witness. Would the lifetime of a man suffice to satisfy the whole world of sceptics, &c." We fully admit that there is a certain force in this reasoning, and we warmly appreciate the spirit of the following passage:—"The public safety is only ensured by our keeping secret the terrible weapons which might otherwise be used against it."

But it seems not to have struck Mr. Sinnett that there are tests of another order far more convincing than "feats," incapable of being mistaken for jugglery, not calculated to arouse popular superstition, not requiring to be seen in order to convince, and which would at once decide whether or no "occultism has been carried in the domain of physical science far beyond the point which we have reached."

Suppose the Brotherhood were to say "Point your telescopes to such and such a spot in the heavens, and you will find a planet as yet unknown to you, having such and such elements;" or "Dig into the earth in such a place, and you will find a mineral containing a metal new to your Science; its atomic weight, its specific gravity, &c., are so and so;" or again, "Dig into such other strata on the slope of the Mount X, and you will find the remains of an animal as yet unsuspected and undescribed, and having such or such characteristics." Such or similar proofs, not of superior *power*, but of higher *knowledge*, would not increase any man's facilities for evil-doing. Were even the smallest evidence of this kind vouchsafed we men of Open Science would be glad to recognise the Brotherhood as our masters, and to trust to their teachings. But in the book before us we find not the smallest trace of anything capable of verification. Till some foothold of this kind is given us it is useless to bid us join the Theosophical Society or change our "mode of life." Teachings so indefinite we are compelled to reject, not indeed "superciliously," but sadly.

Koot Hoomi is reported as saying, in proof of the difficulty of communicating any of the knowledge of the Brotherhood to an outsider, "How could the phenomena of our modern electrical science be explained to, say, a Greek philosopher of the days of Ptolemy, were he suddenly recalled to life, with such an unbridged *hiatus* in discovery as would exist between his and our age?" Mr. Sinnett, in his own person, argues in a very similar style in an earlier part of his work.

To both we reply that it is found practicable to explain, if not all the niceties, yet the main outlines, of modern electrical science to schoolboys who at the outset know certainly less of the subject than would the Greek philosopher of the days of Ptolemy!

II. WILL-O'-THE-WISP: A CONFESSION.

NOT often has "dry" Physical Science to deal with the phenomena which figure in folk-lore. Such an exceptional case is afforded by the nocturnal occurrence known to the learned as *Ignis fatuus*, and to the unlearned in different countries as Jack-o'-Lantern, Will-o'-the-Wisp, Wild- (or rather Wold-?) fire, Friar's-Lantern, *Feu Follet*, Heerwisch, &c. The exception deserves the more notice as modern chemistry and physics have by no means succeeded in finding a satisfactory explanation of the facts. Facts they undoubtedly are. The *ignis fatuus*, though by no means common, has still from time to time been observed by competent witnesses, and occasionally by several persons in company. Nor is such evidence disputed: let any man of sober habits and ordinary truthfulness state that he saw a Will-o'-the-Wisp at such and such a time and place, and the most sceptical of our orthodox *savants* will listen with calm interest, and, though he may question the narrator closely as to the circumstances of the case, he will by no means proclaim it *à priori* impossible, or throw out any insinuations concerning "dominant ideas."

If we examine and compare the most recent and trustworthy records of this phenomenon, we find it described as a light which appears in calm, mild nights, chiefly in summer or autumn. It is most commonly observed in swampy or marshy places, or where much organic matter is undergoing decomposition. Dr. Phipson* describes it as most common in England, "in the peaty districts around Port Carlisle, in Cumberland," on the Continent "in the damp valleys between the pretty little university town of Marburg and that of Cassel, and more certainly still in the graveyards outside the town of Gibraltar." The light in question is generally single, though sometimes two wisps are said to have been seen together. It glides or bounds along at a variable speed, sometimes maintaining the same vertical level, but at other times rising, falling, and overleaping hedges, trees, &c., and may often be tracked to a distance of a couple of hundred yards from the spot where it originates,

* Familiar Letters on the Mysteries of Nature. London: Sampson Low and Co.

or rather where it is first observed. It is recorded as in many cases moving *towards* a pool or swamp, and there disappearing. The light is said to be sometimes globular, spheroidally elongated, or pear-shaped, about the size of "two fists," and varying in colour and brilliance, being sometimes visible even in the light of a full moon.

So much for points authenticated by the accordant testimony of trustworthy observers. Popular tradition adds much more. The spectators are said to have sometimes received sudden blows or shocks. According to an old German story, some village children having irritated a Wisp by crying out—

> "Heerwisch ho, ho, ho!
> Brennnst wie Hafer stroh!"

it pursued them into a house, and stunned every person present by blows with its fiery wings. Folk-lore, indeed, distinctly personifies the Wisp, and ascribes to it the intention to mislead the solitary traveller and entice him into a swamp or pond.* This view or superstition is by no means extinct, as will appear from the following extract from "Light" (June 24th, 1882, p. 296). A contributor of that journal, who uses the *nom de plume* "Miror," gives the following account as narrated to him by an old cottager:—

"'When I was a ploughboy, at Purbeck, I was sent to the blacksmith, who lived some distance off, with some harness to be mended. The blacksmith was at chapel; this delayed the work, and it was not till half-past nine in the evening that I could start for home. It was pitch dark, and as I went along a Jack-o'-Lantern came hopping before me. It was not above the size of your two fists. I was quite aware that Jack-o'-Lanterns came to lead you out of your path, so I kept my foot in the rut all along the country road, till *he*, the Jack-o'-Lantern, hopped over a gate where there was a pond close by, and tried to entice me there.'

"At the above very evident testimony of evil intention the boy was overwhelmed with fright, and taking to his heels rushed, he knew not where, till he came to a house. There they took him in, and one of the inmates accompanied him over the fields, and put him on his way home.

"'I had not gone far,' continued the old man, 'before another Jack-o'-Lantern came hopping before me, and tried to entice me to a swamp which lay on one side of my way;

* We cannot help here remarking that mediæval tradition personified certain phases of the nightmare, as the terms Incubus and Succuba sufficiently testify.

but I knew where I was, and went straight for home, half dead with fear. Never again would I go to that blacksmith's of an evening.'

"'If he had not kept his foot in the rut,' broke in the old woman, his wife, 'it might have been all over with him. When a Jack-o'-Lantern gets you in the water, then he sniggers; he laughs, you know. I've heard my father say that scores of times.'

"Thus we see the old woman brought forward the testimony of her father also, with respect to the traditional shady character of the Jack-o'-Lantern, or Will-o'-the-Wisp, or *Ignis fatuus*.

"'You call the Jack-o'-Lantern *he*,' I said. 'You talk as if you thought it knew what it was about; and by luring you into danger it had an object in view, and not a good one.' 'Just so,' said the old man. I said I was inclined to agree with him.

"On the man's assenting to the woman's assertion that 'when a Jack-o'-Lantern gets you into the water, then he laughs,' I pressed the question, 'Do you really mean to say that they are really *heard* to laugh—that they make the noise of laughter?' 'Yes,' was the reply. 'But how,' I rejoined, 'can people know that they laugh when those who are led by them get drowned, and do not live to tell it?'"

It is curious that "Miror" speaks of this his own objection—fatal, as it appears to us—as "rather lame special pleading on my part." It must not be forgotten that the occurrence is said to have taken place at Purbeck. Now in the counties of Dorset and Wilts the tendency to personification is very strong, and the country people speak of many things as "he" which in the Metropolitan District and the Northern Counties are always referred to as "it."

A very full and definite account of the appearance of an *Ignis fatuus* is to be met with in a modern work* reviewed in our current issue. Some passages of Mr. White's narrative we quote. The inhabitants of Itapua, a small town in the La Plata States, situate on the River Parana, were during the author's stay alarmed by "a mysterious light that appeared almost every night in the second plaza, situated on the high river banks, but where, nevertheless, the ground was in some parts a temporary swamp, from the rains settled in the hollows. In this plaza were posted the line soldiers' barracks, and to the guard bivouacking round

* Cameos from the Silver Land, by E. W. White, F.Z.S. London: Van Voorst. Vol. ii., p. 447.

their fire at night it first manifested itself. My friend Lieut. Morcillo, the officer in command, soon got to hear of it, and, scenting trickery, issued notice that he had given his soldiers orders to fire upon it whenever and wherever it became visible. The soldiers, as they became more accustomed to the *Ignis fatuus*, began to style it the "Plazera." Singular to relate, no sooner did the light burst forth than it was heralded throughout the town by a universal chorus of howls from all the mangy curs in Itapua. In order to elucidate the mystery Lieut. Morcillo and myself visited the plaza for several nights in succession, accompanied by three or four soldiers with loaded rifles and ourselves armed with revolvers. The military were posted round the square, and we waited from 10 o'clock till 12 or 1 in an atmosphere bathed in the brilliancy of a full moon. Only twice was it seen by me, but then very distinctly; the first time some little distance off, but the second quite close. On the first occasion the light started up from the ground with the brightness and speed of a rocket, and then again descended to the earth with equal velocity but less splendour: on the second we caught sight of it as it directly, but gently, approached along the road, upon which, running to intercept it, and stumbling at every step over rough and swampy ground, we managed to arrive within 3 yards of the glowing vision as it slowly glided on at a level of about 5 feet from the earth. It presented a globular form of bluish light, so intense that we could scarcely look at it, but emitted no rays and cast no shadows; and when about actually to grasp the incandescent nothingness, suddenly elongating into a pear-shape tapering to the ground, it instantly vanished; but on looking round up it rose again within 50 yards, but this time we could not overtake it, as it bounded over a hedge, then over trees, and finally disappeared in an impenetrable swamp. According to the testimony of the soldiers, on another occasion, they beheld it rise from the swamp and perch for some minutes on the top of the roof of a neighbouring rancho without walls, after which it pierced the roof and subsided in the ground beneath; but in our case there was no deception, and moreover we noticed that it never appeared on a windy night nor after rain." The author adds, in comment, "Although the marsh-gas theory presented itself to my unwilling mind, it would have to be strained considerably to be able to account for all the attendant circumstances."

We will now attempt an examination of the various hypotheses proposed for the explanation of the Wisp.

Trickery may be at once set aside as out of the question.

The movement of the light is totally unlike that of a man carrying a lantern. It is at times much swifter, overleaps objects which a man could not surmount, and plays often over water and at heights of from 20 to 50 feet in the air. Neither can we consider that it is produced by the reflection of a light thrown from some neighbouring house. Fireworks are equally out of the question. Not to speak of the slowly progressive movements of the Wisp sometimes observed, it is in the highest degree improbable that any trickster would convey a quantity of pyrotechnical appliances into solitary moorlands, woods, and peat-bogs, in order to alarm some stray traveller.

Another hypothesis, advanced by certain very learned authors, such as Ray, Willoughby, Kirby, and Spence,—ascribes the Wisp to luminous insects. Dr. Dereham and Dr. Phipson combat this view on the ground that such insects "rise far higher in the air than does the Wisp, and present the appearance of hundreds of little specks of light." This argument seems scarcely valid; luminous insects are in all probability more numerous than is ordinarily supposed, and vary considerably in their habits. Not all are high flyers, nor are they all gregarious. The apparent size of the light may be considered a fatal obstacle, since no known English insect emits a light of the size of "two fists." But a light seen in a dark night by a superstitious and terrified ploughboy will very naturally be described—and that without any conscious or intentional exaggeration—as much larger than it really was. The circumstances that the Wisp is chiefly seen in calm weather and during the summer season are in favour of this supposition. But we have some positive testimony to advance. The Rev. Dr. Sutton, of Norwich, informed Dr. Kirby that when he was curate of Ickleton, in Cambridgeshire, in 1780, a farmer of that place, of the name of Simpringham, brought him a mole-cricket (*Gryllotalpa vulgaris*), and told him that one of his people, seeing a *Jack-o'-Lantern,* struck at it and knocked it down, when it proved to be the insect in question. Mr. Main ("Mag. of Natural History," n. s., i., p. 549) was told by a farmer that he had encountered and knocked down the luminous object, which he described as being exactly like a "maggy longlegs" (*Tipula oleracea*), an insect, we must add, especially abundant in boggy and marshy lands. Dr. Dereham, the opponent of the insect theory ("Phil. Trans.," 1729, p. 204), describes an *Ignis fatuus* which he had personally witnessed as flitting about a thistle—a very likely action for an insect, though very unlikely for a volume of inflammable gas or for an evil

spirit. Mr. Sheppard informed Dr. Kirby that when travelling one night from Stamford to Grantham, on the top of a stage-coach, he observed "for more than ten minutes a very large *Ignis fatuus* in the low marshy grounds, which had the same motions as a *Tipula*, flying upwards and downwards, backwards and forwards, sometimes as settled, and sometimes as hovering in the air." It is remarked that in this case the wind was very high, so that a vapour would have been carried forward in a straight line, which was not the case. We are well aware that the insect-theory is not free from difficulties. Thus the question at once arises, Why is this phenomenon so rare? It is also to be asked whether the light given off by insects is sufficiently strong to be visible at such distances as the Wisp is said to have been?

The orthodox theory at the present day—that of spontaneously inflammable gases, hydrogen phosphide, marsh-gas, and possibly hydrocarbons given off by decomposing animal or vegetable matter, is open to even more formidable objections. The presence of the spontaneously inflammable variety of hydrogen phosphide has never yet, we believe, been analytically demonstrated among the gaseous matter given off from marshes, pools, and cemeteries.

In Brande's "Dictionary of Science, Literature, and Art" (ii., p. 191) the Wisp is ascribed to "the issue of marsh-gas from the earth. This gas, being ignited either accidentally or intentionally, continues to burn with a flame sufficiently luminous to be well seen at night." The writer admits, at the same time, that no natural production of spontaneously inflammable gas has ever been observed. Dr. Phipson gets over the difficulty of ignition by assuming that the gas given off consists of marsh-gas through which a small proportion of hydrogen phosphide is diffused. But an emission of inflammable gases from the earth or the water, however ignited and however composed, will not account for the phenomena in the majority of cases on record. In proof of this let anyone perform the simple experiment of stirring up the mud at the bottom of a dirty ditch or pond, and ignite the marsh-gas given off by means, say, of a piece of taper fixed at the end of a fishing-rod. The gas will burn immediately over the surface of the ditch or swamp, but the flame will not travel away for considerable distances, overleaping hedges, stiles, trees, or buildings, or playing over thistles. Further, it is found that the Wisp is most common in calm, fine weather, when the barometer is high. But gases pent up in the soil, in marshes, &c., will be most readily evolved

when the barometer is low! Rainy and windy weather is not unfrequently foretokened by the rise of bubbles of gas from the bottom of ponds and marshes. We can readily understand, however, that a light produced by inflammable gas might, if the supply was large and constant, hover over an extensive marsh or graveyard. But in such cases it would not be one and the same portion of luminous matter flitting up and down, but a succession of fresh bubbles, jets, or puffs of gas becoming ignited in turn. This accords ill with the facts as reported by observers; they generally speak of a single continuing light.

Another hypothesis refers the phenomenon to electricity. We always find that the less any person knows about electricity the more easy he finds it to account for any unexplained facts by its agency. Luminous appearances of electric origin are certainly well known such as the "Castor and Pollux," which appears at the extremities of the masts of ships during stormy weather. Similar lights have been noticed, especially in mountainous regions, attaching themselves to umbrellas, lances, alpenstocks, &c. But these phenomena seem essentially distinct from the true *Ignis fatuus*, which, as we have already said, is characteristic of fine weather, and moves about instead of attaching itself to pointed objects.

In all probability several distinct phenomena have been confounded under the name of *Ignis fatuus*, and further careful observation is required for their respective discrimination. Those persons who live in or visit regions where the Wisp occurs might do good service by noting all the circumstances of each case at the earliest possible opportunity. The nature of the soil, the barometric pressure, temperature, the wind, and in short the entire character of the weather, should be recorded, and an attempt should be made to take the spectrum of the light.

It appears that the mediæval and popular notion of the Wisp—a conscious and evil-disposed being—is again brought forward by persons of education. "Miror," whom we have already quoted, whilst accepting the hydrogen phosphide hypothesis, asks further—"May not, however, Spirits of a low and malicious order, bent on mischief, when they find a natural medium in the dark, under circumstances favourable to their malice, make use of this gas, found in marshy places, to suit their purpose? Or may not an evil Spirit, fond of marshy places, have the power to turn an *Ignis fatuus*, that has its rise from natural causes, into a

devious course for an evil purpose?" We reply that there is no satisfactory evidence of purposiveness, good or evil, in the movements of the Wisp.

III. BESTIARIANISM *v.* COMMON SENSE.*

OF all the movements and agitations—religious, moral, social, or political—by which society is at present convulsed the Anti-Vivisection, or, as it is better called, the Bestiarian crusade, must be pronounced the strangest. Strange it appears to be in almost every respect; the object against which it is directed is in its extent utterly insignificant, and to the great mass of the public even non-apparent. The novelist, the lawyer, the dog-fancier, &c., do not witness physiological experiments, do not even read about them, and but for the labours of busybodies would not even be aware of their occurrence.

Further, most "movements," however much they may have been helped forwards by the arts of the rhetorician, have to some extent sound, straightforward arguments at their command. The Bestiarian agitation seems, to us at least, to have relied exclusively upon misrepresentations and inflammatory appeals to popular ignorance,—ignorance as gross often among prelates, statesmen, and peers, as among working men and small shopkeepers. Artfully designed catchwords have been coined. Just as a couple of centuries ago to call a woman a witch was to ensure her destruction, so in our day to pronounce any practice "cruel" is to obtain its unenquiring condemnation. To a foreigner these curious outbursts of extreme humanity in the classical home of pugilism, of wife-beating, and of "sport,"—in the country where cock-fighting is experiencing a revival,—are strangely suggestive. Question-begging epithets, terms left undefined,

* Experimental Physiology, its Benefits to Mankind. By RICHARD OWEN, C.B., M.D., F.R.S., &c. London: Longmans.

The Uselessness of Vivisection upon Animals as a Method of Scientific Research. By LAWSON TAIT, F.R.C.S. Birmingham: Herald Press.

The Ethics of Vivisection. By Dr. S. WILKS. Contemporary Review.

well-known truths overlooked, arguments systematically ignored have been the very sum and substance of the onslaught upon physiological experimentation. Two national peculiarities have greatly facilitated the task of our enemies. John Bull, in spite of his vaunted common sense and practicality, is especially liable to be thrown into a state of stampedo. Like his four-footed prototype, when the buzz of a gadfly is heard, he gallops over any and everything, and will some time, in one of these fits, break his own neck, which will of course be a case of "magnificent self-abnegation!" And such gadflies are among us fearfully common. We are likewise as a nation apt to listen with devout credulity to persons of rank and "consideration," however little acquaintance they may have with the question at issue.

That by these and kindred means "a strong and widespread public sentiment" has been created, we do not dispute. But we can have no respect for such sentiment. We can put it on a level only with the hallucinations of a fever-patient or a lunatic. It must indeed be remembered in this connection that insanity in its formal and acknowledged shape is multiplying out of all proportion to the increase of the population. Serjeant Cox calculated that, if the growth of insanity continues at its present rate, we shall have, in another thirty years, a million and a quarter of lunatics in these kingdoms. It may be asked by someone, What is the bearing of this view upon the question? It is simply this: when in an unhealthy climate, or in a sickly season, the death-rate is high, we may be sure that the amount of disease and debility not proving immediately fatal will be much higher. In like manner, if insanity is augmenting in any country, we may be sure that there will be its increasing penumbra of *semi*-insanity,—of people who though not put under restraint, but allowed to write and make speeches and vote, are not guided by sound reason, but by passion and sentiment. Could we search the Bestiarian ranks we feel confident that we should find multitudes of this class—perhaps, even, some who might with advantage to their own health be put under restraint and due treatment.

Many persons have felt staggered by the fact that a few physicians and surgeons have thrown in their lot with the enemy. The leaders of the movement are obviously aware of the effect which such defections produce upon the public mind, and lose no opportunity of parading such "doctors" at their meetings. We must, however, call the attention of our readers to certain considerations which will solve this apparent anomaly. Though most medical men are, in the

true sense of the word, "men of Science," this cannot be predicated of all. There are some who are indifferent to the acquisition of further knowledge concerning the phenomena of life, health, and disease. They do not seek to discover anything. We could name a very able practitioner, a teacher of physiology at one of the most eminent provincial medical schools, who quite ignored and sneered at the microscope. Such men are quite content to go on prescribing or operating as they did on first obtaining their diplomas; and by means of a mysterious, incommunicable tact they may be very successful. But they do not advance medical science by a single hair's breadth. Their style is clever rule-of-thumb.

There is a much lower grade of practitioners who enlist in the Bestiarian ranks. The medical profession is overcrowded. Can we therefore wonder if some, who have little prospect of rising by more legitimate means, seek to avail themselves of the popular mania? To be proclaimed at the tea-tables a "dear nice man," who does not meditate any treason against the *alter ego* of any gossip present; to-wit, her spiteful pampered lap-dog may, in commercial phrase, be "made to pay."

Lower still: there are, we understand, "Doctors" whose names are not to be found in the "Medical Directory," who are brought forward as representatives of enlightened and advanced medical opinion. Whether these worthies possess any registerable qualification, or are merely the holders of bogus diplomas,* and whether they are paid for their appearance on the platform, we can only surmise.

We do not for a moment insinuate that Mr. Lawson Tait belongs to any of these classes. On the contrary, we know him as an investigator whose researches we have had the pleasure of noticing in the "Journal of Science," and of whom we had hoped much better things.

Before entering upon an examination of Mr. Tait's memoir, which is a reprint from the "Transactions of the Birmingham Philosophical Society," we must bring forward two considerations which to us seem to involve the Bestiarian party in an absolutely fatal dilemma. We ask, in the first place, Why should it be less defensible to inflict suffering upon animals, in pursuit of knowledge, than from any other motive or with any other purpose? This question, though it

* Within half a mile of the place where we sit writing resides, or lately resided, a worthy who for a consideration in money will procure for any applicant degrees in any faculty, or, for the matter of that, an order of knighthood or a title of nobility.

has been put in various forms,* is invariably avoided by the Anti-Vivisectionists. They feel—must feel—that it is an inconsistency, in spite of that well-worn catch-word, "Two blacks do not make one white," of which Lord Chief Justice Coleridge is said to have delivered himself. Let us bring forward a few instances of this inconsistency, that they may be duly valued by the reader, reminding him first that almost every conceivable experiment upon a vertebrate animal, whether involving bodily lesion or not, may be construed as an infraction of the Vivisection Act.

Two men, for a wager, flay some frogs alive, and sprinkle salt upon their bodies "to see which would jump the farthest." The magistrate before whom they are brought dismisses the case as not coming within the scope of the law, remarking, however, gravely, that had the operation been performed for a scientific purpose the defendants would have been liable to heavy penalties.

A boy impales a frog on a fish-hook as a bait for pike, and leaves it to writhe and struggle all night in the water. He also has broken no law, nor has he "violated public sentiment." But if he, in an unlucky hour, feels disposed to watch the circulation of the blood in the web of a frog's foot, and ties this member down so as to admit of its inspection under a microscope, he has then incurred the risk of a heavy fine, and has indulged in an "Orgy of Diabolism."

Yet again: an angler hooks a salmon, and "plays" it for (say) an hour.† All this while the victim has been suffering from slow suffocation. The hook fixed in the mouth will also have been the cause of something more than mere inconvenience. All this prolonged "torture" is, however, perfectly legal, and the angler, after enjoying his favourite pastime, may indulge in Bestiarian harangues, no man twitting him with hypocrisy! But suppose that, in order to study the vital conditions of fishes, whether from an abstract or an economical point of view, he places oceanic species (say) in an aquarium filled with brackish water; he is then guilty of vivisection, and all its pains and penalties, legal and social, fall upon his devoted head.

Further, we have seen Buckinghamshire farm-boys drench a newt with petroleum, and set it on fire. For this there is no legal penalty, and our mild remonstrance was met with

* See Prof. Owen's work, p. 37; also "Journal of Science" for 1876, p. 318.

† We have heard of cases where a vigorous fish has struggled for a longer time.

an actual volley of choice rhetoric and a promised one of mud and stones. But did we take a brood of newts, and endeavour, by gradually modifying their surroundings, to convert them in a series of generations into a terrestrial form, we should be at the mercy of the enemies of research, and might at any time undergo a prosecution made purposely as expensive as possible.

Any man may keep a cobra, and may, if he likes, feed it upon guinea-pigs or young rabbits. So far he is perfectly safe; he may even take pleasure in watching the death-struggles of the victims. But if he, before throwing a guinea-pig to the cobra, administers to it some supposed preservative and notes the result, or if he takes away the bitten creature and tries in any way to cure it, or if he seeks in any manner to derive instruction from its death, he will be hauled before the magistrate.

One more instance of this nature, and we must pass on: rats and mice are viewed in the light of convicted criminals, liable to execution. Everyone who finds them on his premises may shoot, crush, drown, or poison them. If he prefers to use poison, he is at full liberty to select aconitine. But if he gives a mouse, condemned as it is, some unknown drug with a view to test its action, or if, in order to confirm the results of chemical examination, he introduces into its body a portion of matter extracted from the remains of a person supposed to be poisoned, directly every "scribbler draws his penknife blade," every stump-orator waxes red in the face with vociferation, and each hysterical lady dog-fancier shrieks out maledictions!

If any of our readers is a Bestiarian—Anti-Vivisectionists do not greatly love this appellation—we would ask him whether he is prepared to justify these inconsistencies, all, be it remembered, the natural outcome of the Vivisection Act, and of the agitation by which it has been obtained and is sought to be extended? Can he, or can any man, seriously maintain that the higher the motive the worse the action? Can he deny that such instances as those given above are grossly inconsistent? To the miserable quirk about "two blacks" we reply with the adage that they who dwell in glass houses should beware of throwing stones. Or, quoting a higher authority than Chief Justice Coleridge, we say—"Thou hypocrite, cast out first the beam out of thine own eye, and then shalt thou see clearly to pull out the mote that is in thy brother's eye."

A vast majority of Bestiarians think it perfectly legitimate to inflict pain upon animals with their own hands or vi-

cariously for a number of objects,—*i.e.*, for food, or for such commercial products as hides, horns, hair, furs, oils, &c; in compelling animals to serve their purposes for labour; in rendering them more submissive by emasculation, for amusement, and for self-defence. As regards the last head all mankind are agreed, save a portion of the Hindoos and certain of their imitators at home. Concerning the former objects, which in the aggregate cause the infliction of a millionfold the torment which results from physiological experimentation, we ask how are our opponents to get over this difficulty? To do them justice they rarely make the attempt; they meet our argument with the conspiracy of silence. They go on ranting about the "cruelties" of physiology, but ignore the greater cruelties of gourmandism, of luxury, of ostentation, and of sport. The "Zoophilist," the organ of the Victoria Street clique, as Prof. Owen well says, "offers no protest against the skinning alive of eels, or the boiling alive of lobsters, shrimps, and winkles." Elsewhere he writes—"The tender-hearted, who howl down the infliction of a slight wound on a single deer, have no remonstrances in favour of the hundreds of the dappled herd which undergo the terrors of the chase, the wounds of the stalker's bullet, and the cutting of the throat to supply the appetite and please the palate of the gourmand." They say substantially "Venison we must have; we can do without information."

The common plea of our opponents, when they condescend to justify their inconsistency, is that of necessity. We utterly reject this plea. "Sport" in all its varied meanings, wherever the word applies to the infliction of pain, terror, coercion, and death upon animals, for the sake of man's recreation, is not necessary. Furs, feathers, silk, even leather, can be dispensed with. Animal food, however agreeable and wholesome, is not essential to man's existence. Millions of our species live in health and vigour without its use. Beasts of burden and of draught might probably be superseded in this age of mechanical invention, at least in settled countries where the roads are good. However this may be, that large proportion of horses which serve merely for sport, for luxury, ostentation, and convenience might be dispensed with. Nor, again, is castration a necessity. Dr. Wilks well says—"One might ask in these sentimental and æsthetic days whether one sigh of pity has ever been raised for these poor maimed creatures?" We understand that but for an accident the Vivisection Act would have been so worded as to include this piece of unscientific vivisection.

Great would have been the confusion among Bestiarian peers and prelates had the slip not been detected.

Here, then, we have the two pictures. On the one hand, millions upon millions of creatures subject to pain and bondage, often for a lifetime, to gratify man's greed and luxury, Bestiarian prophets and Mænads looking on without feeling "sick at heart." On the other is a vanishing number of animals subjected to pain in the pursuit of knowledge, and here the Prophets and Mænads burst into frantic outcries. They then suddenly think that we "have no right to torture the creatures of God for the sake of any supposed benefit we might derive from doing so." They strain at the gnat after swallowing the camel. Did we not know man's power of self-deception, especially when under the influence of fanaticism, we might pronounce Bestiarians—with the exception of such as, like Mrs. A. Kingsford, M.D., strive to be consistent—the most amazing hypocrites that the world has ever known.

(To be continued.)

IV. EVOLUTION BY SEGREGATION.

IT is now generally conceded by those whose previous studies have made them able to decide, that Evolution, broadly speaking, must be accepted as the mode in which organic species, as we see them, have come to exist. But in what manner this process of Evolution has been effected, what is its cause, and what are its laws of action are still very open questions. The theory of Natural Selection, as originally put forward by Darwin and by Mr. A. R. Wallace, is certainly not gaining ground. Not to speak of the arguments brought against it by Prof. St. George Mivart,* within the last few years it has become almost a truism that before Selection of any kind can come into play there must be varieties among which to select. It is also contended that the struggle for existence—the reality and intensity of which no one seeks to deny—must tend, in the main, to

* Genesis of Species.

lessen rather than to augment the multiplicity of animal and vegetable forms. Hence it will be rather a negative than a positive factor in the origin of species, not so much favouring the origin of new varieties as eliminating those—*ex hypothesi* the majority—which are not in harmony with their surroundings.

We may even venture to infer that the variety and richness of any flora or fauna will be inversely as the severity of the struggle for existence. This is no mere supposition, since wherever that struggle is intensified by man, whether through his own direct agency or through his introduction into any region or island of foreign plants or animals, the immediate result is the extirpation of a number of the indigenous species, and the diminution to that extent of the total number of organic forms present on the globe. An instance of this kind, in California, is noted and commented on by Dr. Behr,* in these words :—"Our original vegetation has very little power of resistance. Its *very variation* is a proof of a certain want of vitality, for any more vigorous organisation, by superseding the weaker ones, would have produced originally the monotony developed at present by the immigration of foreign plants." "Species," says Mr. Wallace, "can arise only where there is room for them." This passage is, we submit, a substantial admission that variation is greatest where natural selection is least active. Instances of a similar kind to that in California are but too plentiful.

The aboriginal flora of St. Helena has been substantially extirpated by the introduction of the goat, the pig, the rat, and the rabbit, conjointly with certain European weeds. Similar causes are at work in Mauritius and its adjacent islands, in the Galapagos, &c., and even in such extensive regions as the Cape, Australia, and La Plata the native flora is being impoverished by the very same cause. The aboriginal birds of the Sandwich Islands will, in another half century, be known only from stuffed specimens and from plates.

On the other hand, we never find, so far, that this intensification of the struggle for existence has led to the formation of any new species, better qualified than the original types to cope with or evade the intruders. The only changes in this direction which we perceive are modifications of habits, in accordance with new or increased dangers, as has repeatedly been observed in the more populous parts of the United States.

* California Rural Press.

The theory of Natural Selection being thus open to doubt under a variety of aspects, we may venture to call the attention of our readers to a hypothesis which, in England at least, has scarcely received the attention it deserves,—the doctrine of Evolution by Segregation, or, as it might be otherwise expressed, by isolation in space. According to this theory, the less the members of a species are crowded or pressed upon—whether by other species or by members of their own—the more likely they will be to strike out into variations which become permanent as good species. Segregation, as well as Natural Selection, presupposes a tendency to vary, whether from internal or external causes, but, as we shall have to show, it throws more light both upon the origin of such varieties and on their preservation. In most other respects the two principles are directly hostile, Segregation ascribing the origin of species to the absence rather than to the abundance of competition between individual and individual, or between form and form.

It has been repeatedly urged, and even presented in a mathematical form, that if, among a numerous species inhabiting one common region, there arises spontaneously some modification which gives its possessor an advantage over its fellows, there is a very slender probability of such variation being transmitted unimpaired, not to say increased, to the next and succeeding generations. Whether the modification is superiority in speed, or in strength, or the possession of a colour favourable to concealment, it is almost a matter of certainty that in the course of a few years, by successive pairings with individuals of the ordinary type, it must become obliterated. Nor is this a mere theoretical supposition which breaks down in actual life. Experiments have been made to improve the half-wild cattle and horses of the pampas of La Plata, and of the llanos of Venezuela, by the introduction of superior Andalusian bulls and English and Arab stallions. But the results prove that a minority of individuals, whatever may be their physical superiority or their other advantages, if mixed with a vast majority of individuals of the common type, and freely interbreeding with them, can effect no permanent modification of the race. In these experiments no natural selection occurred, though the struggle for existence was manifested under the most favourable conditions.

But let us suppose that among the animals of a certain species inhabiting a given region a few stray away from the ordinary haunts of their kind, or, in a word, emigrate. It may well happen, as Herr Wagner suggests, that individual

animals which vary somewhat from the majority of their species will suffer persecution, and will therefore be relatively more likely to emigrate. Among such individuals—exposed as they probably would be to a change of climate, of soil, of food, of outward conditions in general—variations would be much more likely to occur than among the original stock who remain under the same conditions as their forefathers. It is true we have got very much to learn concerning the influence of external circumstances upon animal and vegetable life. But, as has been shown by Semper in his interesting work,* this influence is not unimportant. Not merely are variations more likely to arise among a small body of emigrants than among the main stock, but those which do occur are likely to be perpetuated in the exact proportion of the fewness of the colonists, and in proportion also as free communication between these colonists and the mother-race is rare or difficult.

This assumption of the formation of species by isolation is supported, as Herr Moritz Wagner (not to be confounded with the Bestiarian, Musikant Wagner) shows at length, by the facts of animal geography. There is no point in Tropical America where all, or even the majority, of its species of humming-birds can be found together. Many of them are confined each to a single mountain, to a certain altitude on that mountain, to a deep *quebrada* or gorge in the Andes, or to one bank of a river.

In many other extensive groups the various species are found occupying adjacent islands or separate portions of a continent, like the links of a chain or the meshes of a net, bordering on or slightly overlapping each other, but not co-extensive. Or when different species of a group occupy a territory in common, they appear still to have distinct head-quarters, and are comparatively rare in others. Of this distribution a very familiar instance may be seen in the English beetles of the genus *Carabus*. These insects are all alike in their requirements and their habits; they feed on the same prey, and have in all parts of England the same enemies to contend with. Nor do they meet with any marked diversities of climate in the different parts of the island.

Yet among the common species we find a great and marked inequality of distribution. *Carabus monilis*, which in the South of England is perhaps the most plentiful of the whole genus, fades away northwards. In Yorkshire it is scarce, and in Lancashire quite a rarity. On the other hand,

* Animal Life as affected by the Natural Conditions of Existence.

C. granulatus is in Lancashire the commonest Carab, but is comparatively rare in the south. Farther north *C. glabratus* becomes exceedingly abundant. It would be hard to point out, after a careful survey of these insects, what advantage the differences of colour and sculpture between one and another of these insects can be in the struggle for existence, —especially as they prey in the night or in the early morning twilight,—and hence their origin, either in England or on the European continent, can with difficulty be traced to natural selection.

Among the chief evidences of the Darwinian doctrine are the phenomena of Mimetism, which have been so ably observed and described by Bates, Belt, and others. It is often found that certain animals, especially insects, closely resemble the colour and the texture of the leaves, flowers, bark of trees, sand, and other objects, animate or inanimate, among which they lurk. Such resemblances enable some creatures to escape the quest of their enemies, whilst other species in the same manner deceive their intended prey. About the facts in question there is no dispute. Before the publication of the "Origin of Species" they had not escaped the notice of naturalists, and, as Herr Wagner tells us, they were the subject of frequent discussion. The Darwinian explanation of the phenomena is perfectly familiar. It is supposed that creatures which were, from their colour and make, easily recognisable, being in contrast with the colour of their habitat, were, unless otherwise protected, sifted out, —gradually eliminated. Those which closely resembled the foliage among which they lived, or the earth on which they crept, escaped and perpetuated their species. Let us take the case of a sandy desert where every creature, as the Rev. Canon Tristram informs us, is "desert-coloured." No one can deny that a red or a brown insect would be more easily recognised by insectivorous birds than if it had been of a stone- or a dull fawn-colour; and supposing one out of a brood of its descendants departed from the heretofore normal colour of its race, and approached the universal fawn-tint of the locality, it would, *pro tanto*, be more likely to escape its enemies and to survive. Hence it is assumed that by degrees the entire population of a desert would have a colouration in harmony with the general tone of the scene.

If the colours and shapes of animals have been modified on this principle, then the facts of mimetism or "mimicry" must be recognised as forming a powerful argument in favour of the formation of species by the process of natural selection. Herr Moritz Wagner, however, explains the phenomena

of mimicry on a quite different principle. He considers that insects and other animals consciously and intentionally seek out lairs and places of abode the colouration of which may agree with their own. Thus if the fauna of the Sahara is of a desert-colour, it is because animals having such a colouration have emigrated thither from the southern slopes of the Atlas, or from the northern regions of the Soudan, and finding themselves in harmony with their new domicile have established themselves there permanently. If the Arctic territories have a number of white forms, in agreement with the snowy colour of their surface, it is not because from a former many-coloured fauna all species not white have been gradually eliminated, but because white species have taken refuge there. The agreement between the colour of an animal and that of its locality is therefore dependent upon the will of the former.

In examining this explanation of mimetism we must begin by fully admitting that animals are known, especially when in danger, to seek hiding-places which agree in colour with their own. Such facts have not unfrequently been observed in aquaria, where small Crustacea, Cephalopods, &c., have been seen to place themselves with wonderful accuracy on a stone or other object closely resembling themselves, and where any spectator not forewarned would scarcely detect their presence. In some cases even assumptions of colour have been observed, in accordance with that of neighbouring objects. The attitudes of butterflies are sometimes intentionally—it would seem—deceptive. The "browns," when resting on the ground with wings erect, let the upper pair sink down between the lower till the spots of the underside are concealed, and then "heel over" so as closely to resemble a withered leaf resting slightly a-tilt.

It is perfectly true that animals purposely and knowingly have recourse to mimetic stratagems to deceive their prey. The tiger and the leopard, in India, are found to imitate most closely the whistling cry of certain species of deer, which are their favourite prey. But there are points in mimetism which Herr Wagner's hypothesis cannot, as far as we see, be fully made to meet. Let us take the case of the mimetic bug (*Spiniger luteicornis*), described and figured by our late lamented friend Thomas Belt.* This insect mimics not merely in colour, but in the movements of its wings and antennæ, a large hornet (*Priocnemis*), and doubt-

* Naturalist in Nicaragua, p. 319.

less finds its advantage in so doing. This resemblance we can to some extent comprehend on the theory of Natural Selection. But we can scarcely admit that the bug has set out on its travels to search for some more powerful insect for which it might be mistaken, and having recognised such a one in the *Priocnemis* has taken up its abode in localities inhabited by the latter. Or, to take a somewhat similar case, the caterpillar of the lobster-moth (*Stauropus fagi*) has in some of its attitudes a very decided resemblance to a spider, and might easily be mistaken for one when lurking among leaves. Ichneumons have for the most part a great dread of spiders, and it is hence exceedingly probable that such a resemblance may save these larvæ from the attacks of their chief enemy. It is here exceedingly difficult to explain this mimicry by emigration. In every country where the food-plant of the larva—the beech tree—grows, spiders are present. Whence, then, can the insect have come in search of a formidable something which it resembles? The change of its food-plant would not affect the question at all. Very many indeed of the mimetic features of insects seem inexplicable upon the migration theory.

As regards "desert-forms" of life there is also a difficulty. Canon Tristram observes that the fauna of Arabia is more thoroughly desert-coloured than that of the Sahara, and hence draws the very plausible conclusion that the Arabian deserts are the older, the fauna of the Sahara not having yet had sufficient time to become adapted to its surroundings. This difference between the faunæ of the two deserts seems to us in harmony rather with the hypothesis of Darwin than with that of Herr Wagner,—with the supposition of selection rather than with that of immigration.

On attempting to summarise the considerations put forward above, it seems to us that Segregation is more likely to favour the establishment of new species than is Selection, which latter appears to be actually reducing the number of existing forms. Segregation also can more readily take into account the influence of those external agencies which must, occasionally at least, exert a transforming power upon organic species. On the other hand, Herr Wagner's explanation of the phenomena of mimetism seems very questionable.

Can the two theories be reconciled? We doubt it, although Prof. Semper is of opinion that Segregation is included in Darwinism. It must be admitted that the struggle for existence may often prove the cause which

impels individuals of a species to emigrate, and thus an indirect harmony may be established between the two theories. In their direct aspects, however, they are diametrically opposite.

V. THE HORSE AND HIS FOSSIL ANCESTRY.

ONE of the most striking pieces of palæontological evidence in favour of Evolution is well known as being presented by the fossil Equidæ. Not wishing to reiterate at length familiar facts, we will merely sum up the peculiarities of this group of animals by saying that *Orohippus*, the earliest known genus of this family, had its fore feet 4-toed, the representative of the thumb being alone wanting, though the middle digit is much larger than the others. Its hind feet were 3-toed. The remains of this species are found in the Eocene deposits of North America.

In the Miocene Tertiaries occur three genera, all 3-toed on both fore and hind feet. One of these (*Mesohippus*) has, however, on the fore feet a rudiment which represents a fourth toe, though it is useless. In *Miohippus* this rudimental fourth toe has disappeared, but the three toes are not strikingly unequal in size, and all of them touch the ground and take part in the functions of a foot. We go a step further: in *Ancitherium* the foot has still three toes, all touching the ground, but the middle one is much larger than the two outer toes put together. All still touch the ground, though the functional importance of the outer digits must have been but trifling.

Another step lands us in the Upper Miocene and the Lower Pliocene. Here occur the remains of another genus, *Hipparion*. Here, though there are still three toes, the two outer cannot touch the ground, and the middle one alone is to be called active.

In the later Pliocene formation we find the fossil skeleton of *Pliohippus* with a foot exactly like that of the *Equus*, the modern horse, which does not appear until the Post-Pliocene. In both these genera there is merely one perfect toe, which is enclosed in a single hoof. The two side toes which we

traced in *Ancitherium* and *Hipparion* are now represented by rudiments, known technically as splint-bones.

If we lay these forms side by side, in what may be called chronological order, we cannot deny that there is here a gradual series of changes, departing more and more widely from the typical 5-toed foot of the Mammalia, and approaching nearer and nearer to the structure of the most recent form of the family, the still living horse.

The general, and we may say the natural, inference drawn from these fossils is, that we have here an instance of those gradual changes of animal forms by which, on Evolutionist principles, existing animal "species"—if we may use the word—have been produced.

But this interpretation of the facts is not universally conceded. There are those who contend that though we have never found an *Ancitherium* in the Eocene, a *Hipparion* in the earlier Miocene, a *Pliohippus* in the earlier Pliocene, or an *Equus* in the later Pliocene, yet it is not impossible but that a further examination of the geological record may disclose the remains of such,—that, in a word, these various forms may have been not successive, but contemporary. The probability is of course exceedingly slender, but the advocates of independent mechanical creation may, if so disposed, claim that it should be taken into consideration.

There is yet a further supposition which has been advanced. Admitting, argue some, that these various forms existed, not simultaneously, but in succession, *Ancitherium* having disappeared before—*e.g.*—*Hipparion* came into being, there is still no positive proof that the later forms are descended from the earlier. They may conceivably have sprung into existence independently of each other, the earlier kinds dying out and the later being created in their room. Whatever we may think of the probability of this hypothesis, like the former it is not impossible, and must be fairly met.

It is therefore fortunate that certain recent researches in which Herr A. Nehring has taken a prominent part, and which he has summarised in a paper read before the Berlin Gesellschaft Naturforschender Freunde ("Sitzungsbericht," 1882, No. 4, p. 47), throw an additional and welcome light upon the question.

In the course of the changes which we have just been tracing in the hands and feet* of the Equidæ, it is not only

* It is convenient to speak of the anterior extremities of a mammal as hands, whether they have any power of grasping or not.

the fingers and toes, and the bones best known as those of the wrist and ankle, which have been gradually reduced in number. Corresponding modifications have taken place in the bones of the fore arm and of the leg. The outer bones of both, the ulna and the fibula, have undergone a corresponding degradation or retrograde development. In *Ancitherium* we find the ulna in proportion strongly developed. The fibula, however, is decidedly weak, and its lower part is applied closely to the inner bone, or tibia; but it is still a complete and connected bone.

In *Hipparion* the process of degenerative change is more advanced. The ulna is so much reduced in the lower part of its central portion, and so closely joined together with the fully developed radius or inner bone of the fore arm, that it is no longer capable of free motion, though it still appears as a complete and connected portion of the skeleton. As regards the hind legs, the fibula of *Hipparion* is interrupted in the middle, and consists of an upper and a lower part no longer connected together.

As we approach more recent times, we find the same changes proceeding further. The ulna of the true modern horse is in its middle portion greatly reduced, and even interrupted, and is connected with the radius in young animals by means of sinews, and in old ones by bony growths.

Now so far it might still be contended, concerning these modifications of the fore arm and of the leg, that they supply no absolute proof of "descent with modification." But sometimes in recent horses and asses we meet with a case of a complete and uninterrupted ulna, just as it occurred in *Hipparion*. Herr Nehring, in proof of this assertion, exhibited to his audience the fore-arm bones of a horse of the Cleveland breed and of an adult ass. These specimens showed that in *Equus caballus*, as well as in *E. asinus*, the ulna is sometimes so far developed as to take the form of the ulna of *Hipparion*. Such cases are more common in the horses of heavy breeds than in such of slighter frame: they are also more common in the ass, which seems to represent a more primitive type among the recent Equidæ.

As for the fibula it is so degraded in the recent horse as to consist merely of a rudimentary portion above, and a lower joint-piece which intimately attached to the tibia. Sometimes, however, as in the Cleveland horse above mentioned, the fibula, though not complete, has the interval between its upper and lower remnants much smaller than in the majority of horses,—not larger, indeed, than it is found in *Hipparion*.

According to Mr. Steel, in the ass complete uninterrupted fibulæ sometimes occur.

Those who deny the descent of the modern horse and ass from the fossil Equidæ are obliged to pronounce these reappearances of ancient types mere unmeaning individual variations,—in other words, *lusus Naturæ*,—and are thus driven to a contention of questionable legitimacy.

To the Evolutionist these departures from the normal type of the horse and the ass are cases of atavism,—reversions to an ancestral structure,—and afford therefore the evidence which connects the recent Equidæ with their fossil progenitors. It will be felt that modifications of the form of certain parts of the skeleton cannot be suddenly, and at one stroke, introduced in all the members of a species or of a genus, but they are established by degrees. Whilst the majority of individuals have already adopted a given change in form, others will be occasionally met with which adhere to the earlier form, and yield but slowly to the existing tendency to variation.

VI. ON TECHNICAL EDUCATION.

By Robert Galloway, M.R.I.A.

(Continued from page 412.)

TO cursory thinkers on the subject of Education it may appear surprising that the middle class, as a class, have not long ago demanded the establishment of public schools in at least some of our important centres of commerce and manufactures, which would provide as suitable an education for their sons as Eton, Harrow, and our other great public schools provide for the sons of the nobility and the wealthy class. Why should the one class be supplied with an education which it is considered is the most suitable to qualify them to discharge most efficiently their duties in after life, and the other class be left unprovided with an education which would be the most suitable to advance them in their future careers in life?

Many causes have operated in preventing the demand

being made. The many do not know what to require; hence they are content with the prevailing fashion in education, for all teaching is to them alike: they cannot distinguish good teaching from bad, nor have they the means of testing whether the education that is being given to their children does or does not train their mental powers. Not knowing, therefore, the kind of education to demand, they are content to allow their children to be as imperfectly educated for their after pursuits in life as they were themselves. This is especially the case with those who have been successful in business; they think the kind of education they received will do equally well for their children, neglecting to perceive the fierce struggle England is entering upon, both in commerce and manufactures, with America and other civilised nations, and the ever-increasing care these countries are bestowing in providing an education suitable for the wants of their middle classes. They have (especially the Germans) their Mercantile Public Schools: the object of these schools is to provide a suitable education for those who intend to devote themselves to a purely commercial career, as bankers, book-keepers, merchants, accountants, clerks, correspondents, &c. Instruction is given in mercantile science, in mercantile law, political economy, book-keeping, correspondence, mercantile arithmetic, chemical and mechanical technology, mercantile geography, history, arithmetic, geometry, German, French, English, and free-hand drawing. In some mercantile centres, such as Hamburg and Bremen, no boy intended for commerce—not even the son of the richest banker—is excepted from the system of training they have established for young merchants. Well might the Right Hon. W. E. Forster, M.P., say, speaking from experience, that a young German who had to make his way in the world as a clerk had a much better chance than a young Englishman,—not because he was naturally quicker, but because, in consequence of the German system, he had received a much better education to fit him for business. Mr. Forster has had the advantage of a twofold experience: he has not only been engaged in commerce, but he has also been Vice-President of our Education Department. They have also their Real Public Schools. The object of these schools is to provide a suitable education for those intended for manufacturing pursuits: the education given in this class of schools is based on the natural sciences and modern languages, as against classics in their classical schools.

Having their elementary schools, their classical schools, their real schools, their mercantile schools, &c.,—in short,

schools suitable for the wants of each class of society,—they are of course far in advance of the English with respect to education; but their school system possesses another advantage over ours, if we can be said to have a school system at all, which is even still more important: their system is a graduated or progressive one; from the rudimentary lessons given in the elementary schools to the highest teaching given in their technical colleges or universities, it is on an ascending scale of instruction; a student cannot pass from a lower to a higher course, as I have shown in a former article is and can be done in this country, unless he is fitted to take advantage of that higher course of instruction. There is in consequence a completeness in every stage of education, each school perfecting its pupils in the branches of education it gives: the pupils, when they pass to the next higher school, have not therefore to commence to relearn the subjects they were taught in the lower one, as is too commonly the case in this country.

This admirable system of education, which has been developed and so successfully carried out in Germany, has been framed, as Mr. Perry states in his article on German Schools,* by a succession of *able statesmen and scholars*, and is modified and expanded from time to time in accordance with the wants of the age.

Although the many do not know what kind of education to demand, a reaction has nevertheless set in against a purely classical training, and this reaction is not confined to the middle classes; the dissatisfied are being propitiated by the introduction of one or more of the natural sciences and the modern languages into the ancient course of studies, even in schools like Eton and Harrow. It is desirable, no doubt, to modernise in part the system hitherto pursued in classical schools; but this by no means does away with the necessity of establishing mercantile and manufacturing schools corresponding to those on the Continent. For to attempt to teach in the same school courses of instruction suitable for those intended for professional life, and for those intended for commerce and manufactures, would end in the ruin of the classical system, and would likewise fail in establishing a good system of modern education.

The amalgamation of the old and the new, and the attempt to make the course of school studies suitable for the wants of all classes, must end in bringing the whole system of education into a chaotic state. "It is easy," Mr. Perry

* Macmillan's Magazine, 1877.

well remarks, "for educational reformers to draw up an enticing plan of study, including the whole field of human knowledge; but the practical teacher knows how little is gained by making a thousand shallow scratches on a pupil's mind, which only confuse and erase each other,—knows that, if you would bring living water from the depths of his nature, you must sink one deep shaft at least."

That we are entering upon a struggle with other nations more severe than has previously occurred all facts and figures go to prove. Mr. Mulhall remarks, in his "Balance Sheet of the World"—"In 1880 the industries of Great Britain attained a point never before reached in this or any other country, *but if we compare the progress made during the decade we shall find it was less* than in the interval from 1860 to 1870, and much less than in the United States during the ten years now under consideration. *But although this is probably the last time that Great Britain will occupy the highest rank in the industrial nations of mankind,* there is no symptom of decline, no diminution in force or energy to cause us any anxiety. . . . There is but one industry, agriculture, in which we have lost ground, the advance of all the rest being so great that the aggregate for 1880 shows an increase of 337 millions sterling. . . . Commerce has not risen so much as in the previous decade, . . . nor does mining show the same advance. Manufactures have grown less than any other branch of national increase. . . . Banking and shipping exhibit an enormous development. This," he observes, "is the more remarkable, as the balance of trade against Great Britain has increased in a degree that some economists consider alarming, viz.—

	Millions Sterling.	
	1870.	1880.
Imports	305	414
Exports	242	278
Surplus imports ...	63	136

Thus the balance of trade against us was 25 per cent in 1870, and 49 per cent in 1880. This is, however, rather an indication," he states, "of prosperity than the reverse, since we see that until 1840 our exports were more than our imports; and Russia and Spain have the balance in their favour, and are steeped in poverty."

It does not follow that because Russia and Spain have the balance of trade in their favour, and are nevertheless steeped in poverty, that it is an indication of our prosperity that the

balance is largely against us. No just comparison, in my opinion, can be instituted between the three countries; they are unlike in all essential conditions,—unlike in race, unlike in industrial resources, and in almost every commercial and manufacturing aspect.

The United States are more exactly comparable—whether as regards race, raw materials, commerce, or manufactures—with England than the countries Mr. Mulhall has selected for comparison. And the balance of trade is now in her favour: the exports were 31 per cent in 1880 over her imports. The consumption of raw material in that country rose 404 million lbs. against 468 millions in Great Britain; but the United States grew 95 per cent of theirs, whilst we had to import 93 per cent of all consumed in our factories. The manufacture of iron and steel has increased enormously in that country: the Americans now make one-fifth of the iron, and one-fourth of the steel of the world. The actual increase of American industry in the decade was 525 millions, whereas the maximum among European nations, that of Great Britain, was only 337 millions. And we had a national debt in 1880 amounting to 774 millions sterling, or £22 9*s*. ratio per inhabitant; whilst in the same year America had a national debt amounting to £390,100,000, or £7 13*s*. ratio per inhabitant. And our national and local expenditure has increased during the last decade 20 per cent, and our national expenditure increases yearly by an enormous sum. Well might the Chancellor of the Exchequer, the Right Hon. Wm. Ewart Gladstone, heave a deep sigh, and wish there were now some Joseph Humes in the House of Commons to assist in checking these enormous yearly increases, when he had to announce that he estimated that the national expenditure this year would be eighty-five and a half millions.

America has adopted free trade for agricultural produce, and will continue it, as she has nothing to fear from any other country in that branch of production; but it is all but certain she will continue to be a protectionist, as regards manufactured goods, until she feels she has attained that perfection in this branch of industry that will enable her to compete with us successfully both in quality and price, and in this she is supported in her view, to a certain extent, by that late eminent practical economist John Stuart Mill. He states, in his "Principles of Political Economy," under the head of "Protection to Native Industry,"—"The only case in which, on mere principles of political economy, protecting duties can be defensible, is when they are imposed temporarily (especially in a young and rising nation) *in hopes*

of neutralising a foreign industry, in itself perfectly suitable to the circumstances of the country. *The superiority of one country over another in a branch of production often arises only from having begun it sooner.* There may be no inherent advantage on one part, or disadvantage on the other, but only a present superiority of acquired skill and experience. A country which has this skill and experience yet to acquire may, in other respects, be better adapted to the production than those which were earlier in the field; and besides, it is a just remark of Mr. Rae that nothing has a greater tendency to promote improvements in any branch of production than its trial under a new set of conditions. *But it cannot be expected that individuals should at their own risk, or rather to their certain loss, introduce a new manufacture, and bear the burden of carrying it on until the producers have been educated up to the level of those with whom the processes are traditional. A protecting duty*, continued for a reasonable time, will sometimes be the least inconvenient mode in which the nation can tax itself for the support of such an experiment. But the protection should be confined to cases in which there is good ground of assurance that the industry which it fosters will after a time be able to dispense with it; nor should the domestic producers even be allowed to expect that it will be continued to them beyond the time necessary for a fair trial of what they are capable of accomplishing."

But whether supported by political economists or not, it seems all but certain that America and continental nations will continue to protect all their important manufacturing industries until they can equal or surpass us in price and quality in our own market, notwithstanding all the advice we may give them to follow our example. Success, they may say, in anything is always attended with more or less sacrifice at the start; and they may also reply, in the language of Prof. Goldwin Smith, slightly altered, that many of your so-called Free Traders are nothing of the kind,—you are merely advocates of a particular tariff, very wisely framed, no doubt, with reference to British industries and interests, but not necessarily suited to those of all the countries in the world. You have had, they may say, men, like Cobden and Bright, who did thoroughly understand the meaning of the principle; but with the rank and file of the movement Free Trade has meant nothing but an alteration of the tariff in their own favour. And they might point to the petition of the Lancashire mill-owners against the import duty the Indian Government levied on cotton goods, when it began to affect their interests; and the subsequent

tax imposed on the long-stapled cotton, though it was requisite for the Indian cotton-spinners to import for the purpose of mixing with the short-stapled native, in order that they might compete successfully with the English cotton goods, as very inconsistent with free-trade principles.

My object in bringing prominently forward statistics, both as regards English and American prosperity, is with the view of impressing upon our commercial, manufacturing, and trading classes, that they, especially, ought no longer to be satisfied with the present system of public education in this country. Our manufacturers especially have too long been content only to know somewhat of the commercial part of their business, and little or nothing of their craft; but even as regards buying I have shown in my work on Scientific and Technical Education, by remarkable examples,—and I could add to them,—that they are frequently unable to buy with advantage from this non-acquaintance with their industry; and the cry that is arising for apprenticeship schools arises from this very fact—our manufacturers being no longer practically acquainted with their industries, but being simply capitalists and employers of labour; whilst the manufacturers on the Continent, owing to the education they have received in their Real Schools and in their Technical Colleges, are entering on their duties with a full knowledge of them, and are, by the excellent education they have received, exercising a marked influence on the development of their manufactures.

VII. SAFETY REJECTED.

AGAIN, as in a long succession of seasons, we have been entertained with high hopes, almost amounting to prophecies, of something at least approximating to a summer. Surely, it has been generally felt and said, after so many ungenial years—either moist and cold beyond the average, or at least affording us dry calm weather only when least needed—we might, on the mere probability of he matter, hope for weather not utterly ruinous to the farmer and the gardener. The cycle of hard winters which

set in with 1878-79 seemed over, and the easterly winds during the spring months were less persistent than usual. Consequently vegetation was unusually advanced, and the appearance both of the field-crops and of fruit-trees was promising. April, however, was colder than the average, and since then the character of the year has declined. The months of June and July must rank among the most unseasonable on record. The temperature has been low, the winds high, the rainfall excessive, the skies generally cloudy by day and clear by night, thus cutting off the earth from the rays of the sun, and allowing it to become chilled by unchecked nocturnal radiation. The hay-harvest has been disastrous, and in many parts of the kingdom must prove an entire failure. Without a speedy change, of which there is little apparent prospect, the wheat will fare no better, whilst in many districts the potatoes are already rotting from excess of moisture and from lack of heat.

We recapitulate these sad facts, not in the spirit of Pessimism, not exulting in the discomfiture of the weather-prophets and of the irrigationists, who in such seasons must surely find their avocation gone, but for the sake of pointing out the consequences of our national rejection of the remedy which is ready to our hands.

Last autumn it seemed as if the drying machine of Mr. W. A. Gibbs, after its successful action had been demonstrated on a practical scale for so many years, was about to meet with general adoption. This consummation has been "blocked" in a most curious and unexpected manner. A Mr. Neison has come forward with a rival scheme, which he asserts he has developed seven years ago, but which he has only made public within the last twelve months. This scheme offers the advantage of immediate, or at least apparent, cheapness, and thus naturally appeals to classes so depleted as the farmers, and indeed the landowners, must be after the recent succession of disastrous seasons.

We are, of course, far from maintaining that the apparatus of Mr. Gibbs is incapable of improvement. The inventor himself entertains no such notion, for, till lately at least, he has been busily and successfully engaged in improving his machinery from the points of efficiency, economy, and durability. It is, however, quite conceivable that some person might see a method of distributing hot air through the hay, corn, &c., to be dried, more effectual than anything as yet suggested.

Mr. Neison, however, as we understand him, moves in another direction. He proposes altogether to dispense with

the coke or anthracite fire used by Mr. Gibbs, and with the machinery for working the hay about in the stream of hot air (see "Journal of Science for 1881, pp. 572, 573). By so doing he effects an apparent economy. But what does he substitute? We cannot obtain power in any shape for nothing. To dry a wet material we must do one of two things: we must either expose it to an increased temperature or to a current of dry air. In a fine season we get one, sometimes both, of these agents for nothing, and need merely expose the material in thin layers to the sun and wind, as in common hay-making. Mr. Neison, instead either of sun-heat or furnace-heat, makes use of a source which persons who, like the majority of farmers, are unacquainted with physical science may possibly consider as cheap as the action of the sun and wind. He builds up his stacks, as we understand, with grass containing its natural moisture, and perhaps soaked in addition with rain. Fermentation sets in, heat is generated, and, as is generally known, without some special arrangement the stack would take fire, as often happens. But to prevent this danger Mr. Neison arranges pipes or channels in the stack through which the heated air is to escape, carrying off the moisture with it, and thus ultimately and in some fashion drying the hay.

In how far this device is novel we cannot pretend to decide. It is not, we understand, protected by letters patent, and some of its advocates have had the questionable taste to sneer at Mr. Gibbs for having taken out patents for his inventions. But, unless our memory completely deceives us, we remember some forty years ago seeing it suggested in an old book, that, when hay has to be stacked in an imperfectly dry condition, a long sack should be first stuffed full of hay or straw, and set upright. Around this sack the stack was to be built. When it had reached its full height the sack was to be drawn out, thus leaving a chimney through which the heated air and vapours might escape.

Again, Mr. J. W. Thomas, F.C.S., published in 1878 a work entitled "A Treatise on Coal, Mine-gases, and Ventilation," in which arrangements for keeping down the temperature of hay- and corn-stacks by means of pipes are described and figured.

However, the question is not so much the novelty and originality of Mr. Neison's device as its efficiency. No one doubts that if we pile up a large heap of vegetable matter in a wet state fermentation sets in, and a very considerable heat is generated. Such instances as hot-beds, the "firing" of ground dye-woods if too damp, the spontaneous ignition

of cotton-waste, &c., are perfectly familiar, and the rise in temperature in beer-worts and wine-must during fermentation is fully known. But the heat thus produced is no more obtained for nothing than is the heat of a furnace. The process that takes place in such heaps of wet vegetable matter is slow combustion ; the carbon and hydrogen of the hay, &c., combine with oxygen to form carbonic acid and watery vapour, and the heat generated is in proportion to the quantity of matter destroyed. It may therefore be said that Mr. Neison dries one part of a stack of hay with the heat generated by burning another portion. Now not only men of Science, but manufacturers of all classes are of opinion that heat may be obtained more cheaply by burning coal than by burning hay or straw. Were it otherwise we should find them buying hay for fuel!

But the case is really worse than if a certain portion of the hay had been taken and burnt in a furnace, in order to dry the rest by means of the heat thus produced. Hay is a complex material, and if it is allowed to ferment—or, in other words, partially to rot—some of its constituents are destroyed more readily than others. The woody fibre, or cellulose, which forms, so to speak, the skeleton or framework of the stalks and leaves of the grass, is scarcely attacked at all. But this cellulose is precisely the least valuable part of grass or hay for the food of cattle. It is but very sparingly digestible, so that the greater part of the dung of cows. &c., is composed of cellulose, ground up into a fine fibrous pulp, but not dissolved.

On the other hand, the sugary matter naturally present in grass, which renders the hay agreeable to the taste of cattle, and which has a considerable nutritive value, is the first ingredient to be destroyed in fermentation. Its oxidation or combustion—for the two words are in such cases practically convertible—is the source of the heat which in the Neison process is to volatilise the moisture present and dry the hay. After the sugar the starchy matter, the albumenoids, and, in short, all the valuable constituents are successively destroyed, and there remains, if the fermentation is only allowed to go on long enough, the woody fibre above mentioned. Instead, therefore, of utilising this heat of fermentation for drying vegetable matters, it should be rendered impossible by at once depriving them of moisture. This is done by Nature when hay is made in dry, sunny weather, with a gentle wind. Such hay retains its colour, its odour, its taste, and its chemical composition, and is, in fact, grass deprived of the greater part of its natural moisture. The same end is

obtained still more perfectly by the use of Mr. Gibbs's drying apparatus. But if fermentation is allowed to be set up the nature of the grass is seriously altered. Its colour and odour are changed, and its chemical composition and nutritive value suffer likewise.

There is another point to be considered: in what may be called natural hay-making the cut grass in a loose open state is continually spread out to the sun and wind, so that every part of it is equally dried. Still more perfectly is this done in the Gibbs process, where the grass is tossed backwards and forwards in a kind of shower, in a current of hot, dry, air. But if we first make up the grass into a stack in the wet state, no matter what air-ducts we introduce and what heat we may apply, it is a physical impossibility for the whole mass to be perfectly and equally dried. One part of such a compact mass might be at a temperature bordering upon redness, whilst a few inches off another portion may still be quite wet.

As a practical and decisive test of the merits of the two systems we may refer to a case which was described in our issue for October last year (p. 572), where a stack of hay had been fired by an incendiary, and partly destroyed. The residue was tainted with the smell of smoke and soaked in water, so that cattle refused to touch it; yet this apparently worthless refuse, after passing through the Gibbs drying machine, came out not merely dry, but completely freed from the smell of fire, and was then readily eaten by cattle. We strongly doubt if any such result could be attained by Mr. Neison's system, or by any process of stack-cooling.

We admit that the machine is too costly for many farmers. But we do not see why—like steam-ploughs, &c.—it might not be let out on hire. It has been repeatedly proved that the working cost of the Gibbs machine is a mere trifle in comparison with the saving effected. The question as between the two systems is not one of practical agriculture, but of physics and chemistry, and if "Agricola" had been better versed in these disciplines he would have come to a very different conclusion.

ANALYSES OF BOOKS.

Cameos from the Silver Land; or the Experiences of a Young Naturalist in the Argentine Republic. By E. W. White, F.Z.S. Vol. II. London: Van Voorst.

In this volume, as in the former (see p. 161 of our present volume), there is the fullest evidence that the author has visited spots of the highest interest to the naturalist, whatever may be his particular department. We see, further, that Mr. White is well able to identify the various animal and vegetable forms which he has encountered. A few passages also prove that he is by no means deficient in the gift of observation. Indeed, we can only account for the comparative lack of original notes on the peculiarities of the Argentine fauna by the supposition that the author has reserved the cream of his experiences for another work, or for memoirs to be laid before some learned society, and is giving us in the present volumes merely a popular survey of his travels.

We learn that the water of the Rio Negro, a tributary of the Uruguay is impregnated with sarsaparilla from the roots of the plants with which the banks are lined. This locality for sarsaparilla is not yet known to commerce.

The description of Paysandu, of ox-tongue celebrity, is somewhat sickening, and may furnish a text for our vegetarian epopts. We notice that the scandalous custom of feeding swine on the offal of the slaughtered oxen prevails here. Hence pork is generally eschewed as an article of diet. The blood, mixed with the intestines is kiln-dried, and converted into manure. Such a rude process must infallibly occasion a grievous nuisance, and deteriorate the value of the product. All the blood does not, however, seem to be utilised, as "bloody streams are seen vomiting their contents to incarnadine the pure bosom of the Uruguay." The description of an island in the Uruguay, near the Montevidean shore, is enough to make the fingers of the naturalist tingle. An island in the same river is described as "rich in splendid agates, blocks of rock crystal, amethysts, and other precious stones." At Salto the author "was surprised to find whole walls built of nothing but fine agates, many of which weighed 25 lbs., and from whose crevices I picked with a penknife good specimens of rock-crystal; the whole district is strewn with amethysts, garnets, chalcedony, and cornelians." There are also water-worn nodules of carbonate of lime "completely enclosing water, so that they can be shaken about like a Toricellian hammer, the whole being beautifully translucent, and very plainly exhibiting the imprisoned liquid, which is said to be

extremely poisonous." The "musical boom" of the *Rhea*, or American ostrich (species not named), is said to be strikingly characteristic, even when heard at the distance of half a mile. A species of cactus (*Tricomaria usilla*) has spines a foot in length. It seems, indeed, as if the vegetation of the southern hemisphere, alike in Australia, South Africa, and La Plata is pre-eminently given to the development of thorns.

In speaking of the now decayed town of Rioja, the author makes the following remark, which is capable of much wider extension: "Politics have been the bane of Rioja, as of most other Argentine towns, especially capitals." Where agitation thrives, not merely discovery and invention, but manufactures and commerce, languish, as we have had ample opportunity of witnessing of late years nearer home.

The following instances of skill, if they occurred in a "dumb" animal, would be pronounced marvellous instincts, and might become the theme of much eloquent sophistry: "These men" —the Rastreadores of Rioja—"will enter a field in the middle of a pitch dark night, and out of a troop of strange loose mules, unerringly lasso their own and march them off, distinguishing those that occupy their several places in the team. Although I have had considerable experience, I never could detect by what sense they were guided."

The people of Rioja, we are told, "have a great horror of bees, and allow no hives within leagues of the city, affirming that they destroy both fruit and flowers, especially of the grapes and oranges." The author calls this an "ordinance based upon ignorance," and so, according to our knowledge, it seems. But we should like to know the origin of this strange notion, and upon what facts, or supposed facts, it has been built.

On the way to Chilecito, Mr. White mentions the humming-birds, "one gifted with song, and others with a distinct whistle." It is to be regretted that he has not mentioned the species, most of the family, as he remarks, uttering merely a shrill chirp. The indigenous ferns of this district he pronounces very similar to those of Europe. The silver mines of Chilecito, if worked with capital and skill, would be unequalled in the world. "Innumerable lodes in the schist yield every form in which that precious metal occurs; fine specimens of native, ruby, and horn silver continually occur, and the rotten quartz, so easily worked, is the teeming matrix of gold." In the Famatina range "lies a tract of about 200 square miles containing hundreds of mines yielding gold, silver, copper, tin, and bismuth, and it is a curious fact that those of gold are always found beneath, and the copper at the top." In these mining districts, bleak and bare, Mr. White saw abundance of mountain doves in pairs, of the exact colour of the rocks, and many very rich and rare humming-birds, which, as he had no fowling-piece with him, he was unable to capture and determine. Near Catamarca is the southern limit of the fire-tail

humming-bird (*Sparganura sappho*). The author considers *Chrysotis amazonica*, a green, red, and yellow parrot, to be capable of a higher education than the well-known grey African species (*Psittacus erythacus*).

It is curious that in the upper provinces of La Plata, though intermittent fever (Chuchu) is common, there is a deeply-rooted prejudice against the use of quinine, which the natives consider rapidly destroys the coats of the stomach. Mr. White, like not a few eye-witnesses, both in La Plata and other regions, not forgetting our own colonies, notes with regret that English manufacturers do not push their interests as they might, and that our goods are thus losing ground, not from inferiority of quality or higher cost. This apathy in face of the frantic efforts made to oust us from the markets of the world is something remarkable.

At Tucuman goitre is very common, affecting about one-half per cent of the natives. It is said to indicate metallic ores, and in those districts where it is most severe limestone does not occur. The railway from Tucuman to Cordova passes over the so-called Salinas, sometimes a plain of glittering salt, but, when Mr. White passed, covered with water, and tenanted by red flamingoes in hundreds of thousands.

At Singuil the condors commit dreadful havoc among cattle in spite of the war waged against them with bullet and poison. In the neighbourhood of Andalgala the vines are standards and yield very heavy crops of fruit. Here the author was in want of small shot, and being desirous of capturing some of the smaller *Trochilidæ* he tried sand and rice. The former stunned the bird but destroyed the plumage, whilst rice broke up in the discharge. The attempt to secure the birds by means of arsenical syrup introduced into flowers met with very little success. Most of the species detected the danger, though a *Patagona gigas* imbibed the poison, became immediately ill, vomited, and was found dead the next morning.

In the neighbourhood of the Aconquija range a peculiar disease attacks strange mules. Animals reared in the district and men generally are exempt from its ravages. A dry and clear air neutralises the virus, but in damp weather or rain the animals are seized with trembling, succeeded by violent convulsions, which quickly prove fatal. The cause of this strange affection is unknown.

At Colalao every seven years a flood of sand and mud descends down the small river, covers the land, and even invades the houses to the depth of seven or eight feet.

The *Leuconerpes candidus*, a species of woodpecker, goes about in families, and passes up a tree from the root to the very top of the stem in corkscrew fashion in a single slow-moving file, each head touching the preceding tail.

Irrigation-canals, however useful in regions where moisture is

deficient, are here, as elsewhere, a source of malaria. In the province of Salta, the real original potato, a small reddish tuber no larger than a walnut, is still in use. A curious instance is given of the ferocity of the peccary. A man, in order to escape a herd of these fierce little swine, climbed up a good-sized tree, leaving his horse tied to the foot. His friends found afterwards that the brutes had not only attacked and devoured the horse, but had uprooted the tree, and made a meal of him also!

The falls of the Parana exceed the much-vaunted Niagara. That of Iguazu is calculated at 174 to 180 feet perpendicular, whilst Niagara is only 144. The width of the Iguazu is a thousand yards, and its volume of water enormous. The Guaira fall is much larger still!

In closing our survey of this work we must pronounce the second volume much more important and interesting than its predecessor. It gives an excellent picture of the capabilities of the La Plata regions, and will, we hope, tempt further explorers to a region whose fauna and flora are scarcely even known in the rudest outline.

A Manual of the Infusoria. Including a description of all known Flagellate, Ciliata, and Tentaculiferous Protozoa, British and Foreign, and an account of the Organisation and Affinities of the Sponges. By W. Saville Kent, F.L.S., F.Z.S., F.R.M.S. 3 Volumes, pp. 913, 51 Plates. London: David Bogue, 1880—1882.

This magnificent work will probably disappoint those microcopists who have been accustomed to a convenient arrangement by which all minute inhabitants of fresh or salt water have been spoken of as Infusoria, a heterogeneous group including not only the Infusoria proper, but various Rhizopoda, Rotifera, and even Acari, besides numerous vegetable organisms, such as the Diatomaceæ, Desmidiæ, and other Algæ. Although such classification, or rather want of it, may bring together those forms most sought after by the pond hunting microscopist, it is somewhat bewildering to the student who wishes to do more than merely name the specimens which come under his notice. He will here, for the first time in any English work, find the Infusoria proper brought together in an accessible form. Limited, as they now are, to a small section of the sub-kingdom, Protozoa, the number of species is surprising, no less than 51 plates, each containing numerous figures, being required to delineate the various forms described in the book.

The introductory part of the work fills more than two hundred pages, and not the least interesting portion consists of the early history of the subject. This, as may be supposed, is intimately connected with the invention and improvement of the microscope, brought into public notice about the year 1619. Nearly fifty years later we find the first account of any attempt at minute scientific investigation in Dr. Robert Hooke's "Micrographia Illustrata." The discovery of the minute organic beings, especially treated on in this work, belongs to Antony van Leeuwenhoek, whose first observations were published in the "Philosophical Transactions," vol. xii., No. 133, for the year 1677, under the following title: "Observations communicated to the publisher by Mr. Antony van Leeuwenhoek, in a Dutch letter of the 9th of October, 1676, here Englished, concerning Little Animals observed in Rain, Well, Sea, and Snow Water, as also in Water wherein Pepper had been Infused." Part of Observation I. may be quoted for the sake of giving a specimen of the old Dutchman's quaint style:

"In the year 1675 I discovered living creatures in rain water which had stood but four days in a new earthen pot, glased blew within. This invited me to view this water with great attention, especially those little animals appearing to me ten thousand times less than those represented by Mons. Swammerdam, and by him called water-fleas or water-lice, which may be perceived in the water with the naked eye. The first sort by me discovered in the said water, I divers times observed to consist of 5, 6, 7, or 8 clear globules, without being able to discover any film that held them together, or contained them. When these *animalculæ*, or living atoms, did move, they put forth two little horns, continually moving themselves; the place between these two horns was flat, though the rest of the body was roundish, sharpening a little towards the end, where they had a tayle, near four times the length of the whole body, of the thickness (by my microscope) of a spider's web, at the end of which appear'd a globul, of the bigness of one of those which made up the body, which tayl I could not perceive, even in very clear water, to be moved by them. These little creatures, if they chanced to light upon the least filament or string, or other such particle, of which there are many in the water, especially after it hath stood some days, they stook entangled therein, extending their body in a long round, and striving to disentangle their tayle; whereby it came to pass, that their whole body kept back towards the globul of the tayle, which then rolled together serpent-like, and after the manner of copper or iron wire that, having been wound about a stick and unwound again, retains those windings and turnings. This motion of extension and contraction continued awhile, and I have seen several hundreds of these poor little creatures, within the space of a grain of gross sand, lie clustered together in a few filaments."

This description agrees with that of one of the species of Vorticella, the "*two little horns*" being the optical expression of the cilia imperfectly seen.

Then follow the observations of Sir E. King, 1693; John Harris and Stephen Gray, 1696; Henry Baker, 1742—1751; and M. F. Ledermuller and O. F. Muller, to whom we are indebted for the first attempt to classify these minute organisms. In the long interval between the publication of Muller's "Animalcula Infusoria," and the appearance of Ehrenberg's world-famed treatise, a considerable number of investigators occupied themselves in the study of these minute organisms. In 1838 the result of fourteen years' study, entitled "Die Infusionsthierchen als Volkommene Organismen," appeared, a work which even now ranks as classical. The imperfection of Ehrenberg's optical appliances led him to attribute to these minute organisms a far more complex structure than they have since been found to possess. Their very simple organisation was first noted by Dujardin, in 1841, and from that period to the present time, owing to the successive improvements of the microscope, and the increased diligence of observers, one discovery has followed another in quick succession.

The five succeeding chapters are devoted to introductory matter, the second containing an account of the sub-kingdom, Protozoa, and the next the Nature and Organisation of the Infusoria; this chapter concludes with some valuable information as to the mode in which the microscopical observations are to be conducted. As must be expected, numerous difficulties are encountered in carrying on observations with the very high powers needed in examining some of the more minute forms. Mr. Kent remarks that the thinnest cover glass made is inconvenient on account of its extreme brittleness and rigidity, and hampers progress in a most provoking manner, and materially restricts the limits of clear vision. The author, as a substitute uses very thin films of talc, which for perfect evenness and transparency will compare favourably with the finest manufactured glass. With the employment of these talc-films the investigation of Infusoria with the 1-16th, 1-25th, or even the 1-50th inch objectives becomes a comparatively easy task. The material in question possesses the further advantage of bending readily, and permitting the object-glass to be brought close down on the more remote objects in the microscopic field, while it may be cut with scissors to any required size or shape.

A description and figure is given of the moist slide employed by Messrs. Dallinger and Drysdale in prolonged observations, and also the way of making use of it.

It would hardly be supposed possible to preserve permanently so delicate an organism as an infusorial animalcule; nevertheless, this has in many instances been successfully accomplished. Osmic acid is the reagent which has been found most effectual.

Applied either in the form of vapour, or as a solution, of strength of from 1 to 2 per cent, in distilled water, the results attained are most remarkable. All structures, such as cilia, cirrhi, and flagella, the internal endoblast, and in *Euglena* and its allies, the colours also are preserved, the animalculæ, excepting for the absence of motion, being scarcely distinguishable from the living organisms. The author has found the most effectual and simple way of applying the osmic acid to be that of placing a drop on the cover before laying it on the slide containing the Infusoria. A saturated solution of potassic iodide in distilled water, saturated with iodine, and diluted to a brown sherry colour, has been found by the author to act in a manner almost identical with that of osmic acid, and in some instances even more efficiently, and possesses the additional advantage of yielding no deleterious exhalations, which have to be carefully guarded against in the use of osmic acid.

The fourth chapter is devoted to a very exhaustive account of the vexed subject of spontaneous generation. No justice can be done in a mere abstract; full details are given of the elaborate experiments of Tyndall and Messrs. Dallinger and Drysdale, and the apparatus employed described and figured. As an instance of the almost universal distribution of infusorial germs, Mr. Kent's account of the examination of some grass may be cited:

"On Saturday, October 10th, 1879, a day of intense fog, the author gathered grass, saturated with dew, from the Regent's Park Gardens, the Regent's Park, and the lawn of the Zoological Gardens, and submitted it to microscopical examination, without the addition of any supplementary liquid medium. In every drop of water examined, squeezed from the grass, or obtained by its simple application to the glass slide, animalculæ, in their most active condition, were found to be literally swarming, the material derived from each of the several named localities yielding, notwithstanding their close proximity, a conspicuous diversity of types [here follows a list of several species of Infusoria, also two rotifers, and various diatoms, &c.], the collection as a whole being undistinguishable from the ordinary microscopic fauna of a roadside pond."

The data elicited through the observations just recorded carry with them an important and far-reaching significance. In addition to the conclusive proof herewith afforded of the primary origin of germs in hay, Infusoria and other minute forms of aquatic life were thereby demonstrated to possess an area of active vital distribution hitherto undreamt of. Water, in its stable and concrete form, is no longer, as hitherto presumed, a requisite concomitant of such vital energy. The smooth-shaven lawn, park-land, and meadow, are each and all one vast teeming city peopled by its myriads of tiny inhabitants, heedlessly crushed under foot in our daily walks abroad. Securely housed in their spore-membranes or encystments, these microscopic

beings slumber undisturbed and unconsciously throughout the dry, dusty summer days, awaiting, however, only the fall of the evening dew or passing shower, to cast off the frail cerements that enclose them, and to re-awake to active sentient life. The concluding paragraph of this splendid chapter is so very suggestive, that no excuse is needed for its quotation:

"One final though indirect result of the rigid scrutiny to which the monads and other low unicellular organisms have been submitted, in order to solve the mystery of their generation, remains to be recorded. As conclusively proved by Professors Tyndall, Dallinger, and Drysdale, Cohn, Kühne, and other investigators, such organisms in their germinal or sporular state can successfully resist exposure to temperatures that prove fatal to any other more highly organised structures, even up to and beyond the boiling-point of water. So far, therefore, as they are brought in contact with the ordinary conditions of the earth's surface, they are practically *indestructable*. Nay, more! as suggested by Prof. Tyndall, there is no reasonable pretext for assuming that there are not germs capable of resisting far higher temperatures than those which have been hitherto subjected to experiment. Hence, among all known organic forms, the infusoria and their allies alone would appear to possess the power of weathering the cataclysmic changes of the universe, and, secure from all influences of heat and cold, of migrating in safety through interplanetary space."

The sixth chapter on classification commences with an account of the first attempt at arrangement by O. F. Muller, in 1786. It is founded on the appearances presented by the limited optical appliances of the time, the leading distinction being the absence or possession of external organs. After deducting various Rotiferæ, &c., and low vegetable organisms, about two hundred species of true Infusoria are described.

Ehrenberg's system depends mainly upon the supposed existence of one or many digestive cavities, or their absence, the structure of the infusoria being supposed by this great observer to be far more complex than more recent observations have proved it to be, after eliminating as before, other forms, about three hundred and fifty species remain. These systems of classification are given in full, as are those of Dujardin, Siebold, Perty, Claparède and Lachmann, and Diesing and Stein.

The author's investigations with high powers among some of the forms of Flagellata, and the discovery of some peculiarities about the oral region, have led to very great alterations in the system of classification adopted in the description of the various species. The three divisions which follow, containing a systematic description of the Infusoria, occupy by far the greater portion of the work, and beside the technical matter of the diagnosis, habitat, &c., gives as much information as can be obtained about each species, in very many cases embodying the author's own observations.

The plates cannot be too highly commended, and are accompanied by very full explanations. The work concludes with an Appendix containing a notice of species recorded during the period of publication, a copious index, and, what is of very great importance to the student, a carefully compiled glossary of the technical terms employed. There will also be found a chronological list of works and papers relating to the Infusoria, from the period of their first discovery, in 1675, to the date of publication.

That the present work is final is certainly not maintained by Mr. Kent, who rather looks upon the matter brought together as making a new starting-point for investigation: vast though the progress has been, much remains to be done; many forms may prove to be only larval conditions when the whole of their life-history comes to be known. With the number of students and workers with the microscope many new forms will no doubt be hereafter discovered, and greatly enlarge the number already known, of which the present book includes about nine hundred.

Irenicon No. 2. *Faith: the Life Root of Science, Philosophy, Ethics, and Religion.* By H. GRIFFITH, F.G.S. London: Elliot Stock.

WE have here a work which, if extending in one direction at least to regions beyond our official competence, has for us not the less a very important aspect. The man of Science and the cultured outsider may possibly not feel bound to accept all the author's contentions. Not the less, however, they will find it wholesome to follow him in his survey of the postulates which underlie our received systems. It is somewhat strange, and to our mind not quite satisfactory, that these postulates should be so completely overlooked.

In our elementary treatises on astronomy, physics, chemistry, biology, the student is told of certain fundamental facts, which he is shown how to verify, to connect, and to explain. But he is not told that underneath these primary facts lies a stratum of assumptions, for nothing else can it be called. And it too often happens that the finished, graduated master ignores what the school-boy has never learned. The old geometrician places his postulates at the beginning of his work. Why should not his example be followed? But of this hereafter.

Mr. Griffith's object is to vindicate the position and the authority of Faith by proving it equally necessary to the existence of Science as to that of Religion. With this purpose in

view he begins his task with an historical introduction, tracing human progress to ideas, "theories crystallized into palpable facts." He insists on the importance of acquainting ourselves accurately with the vicissitudes of public opinion. Creeds—and we presume the author does not here mean religious beliefs only—are "normal growths, not loose, independent occurrences to be chronicled like the items of an auctioneer's catalogue. Let a system of belief be ever so false or absurd, to speak of it as an outburst of mere caprice" is a misinterpretation. "Call it a weed, if you like, but remember even the most noxious weeds require roots and appropriate pabulum no less than the choicest flowers." At the same time it must be admitted that many beliefs and "movements," ancient and modern, are distinctly pathological—normal only in so far forth as like a cancer or a carbuncle they are not uncaused.

Mr. Griffith, proceeding with his survey of the history of opinions, has a good word for the Alexandrian School, though fully admitting that it produced "no standard original works in Science." He does not appear to share the recent, and as it seems to us well-grounded, scepticism concerning the destruction of the Alexandrian library by the Islamite conquerors. We suspect that the worthy Bishop Cyril and his monks had left little of scientific value to be destroyed.

Mr. Griffith's views on one of the burning questions of the day are given in the following masterly passage:—"All my individual proclivities are in favour of liberty. But that confession notwithstanding I can find no possible room for doubt in regard to the broad declaration that Mind no less than Matter is subject to definite law. A thought or emotion, absolutely self-evolved and self-sustained, is nothing short of an absolute self-contradiction. We have still much to learn on these points, perhaps also not a little to unlearn, before we arrive at anything like logical consistency. Happily freaks, exceptions, abnormalisms, *lusus Naturæ*, and all ideas of the kind have long since been banished from Philosophy. It is full time to get as cleanly rid of them in Theology. It they have any meaning at all it must be an essentially Godless one, however veiled in Scripture phraseology."

Mr. Griffith, in commenting on the fact that we cannot help having the notion of causality, and that our inability to point out the cause of any given phenomenon is no proof of its lawlessness, takes the illustration of an observer seated on the top of a coach and looking down one side at two of the wheels. "Precisely because the said wheels are actually running the same way, each on its own centre, they must appear to him to be turning in exactly opposite directions, though to outside spectators it is clear that all the said wheels are working in obedience to one common impulse." Hence he asks:—"May there not in this strangely composite world be a thousand other seeming contradictories which a change of position on our part would in-

stantly reconcile, and perhaps convert into obvious concurrences." We are here reminded of some interesting speculations put forward by Mr. W. Crookes, F.R.S., in a memoir on "Gravitation as a Factor in the Organic World,"* in which he shows that our perceptions of external nature and our modes of interpreting phenomena are to a very great degree modified by our size.

Mr. Griffith also suggests that "time has difficult problems of its own, perhaps still more formidable than those of space." He continues:—"There are yet other cases innumerable where the antecedent and the consequent appear to run on such essentially different planes, that no common data are left us for determining the relation in which they stand to each other." The illustration which he selects is not in our opinion either well-chosen or well handled, as it would be easy to show did space permit.

As to alleged apparent suspension or modifications of forces, he writes, "Our very definition of a miracle throws it at once entirely outside the domain of Science—not in the least as invalidating, superseding, or amending any previously existing laws, but as springing from the orderly co-working of certain higher and more comprehensive laws, the full meaning or value of which it is beyond the power of human language to express.

Our author comes now to a consideration of the "Principles and Method of Induction," in which as also in other portions of his little work, he criticises justly—and therefore severely—the illusory system known as "positivism," or "Comtism." Whilst recognising the value, or rather the necessity of Induction, he points out that the utmost discrimination is required in arguing from the few to the many. As to the Comtean canon of confining ourselves strictly to phenomena, he owns that "speculation (in the philosophic, not in the gambling sense of the term) has its dangers, but not to speculate at all is simply not to think, or, in other words, not to be worthy of being called men." He further contends and shows by examples that absolute perfection of observation is unattainable. "As all our sensations are reactions of mind subsequent to long successions of intermediate material changes it is manifest we never can see any event exactly at the right time, or any object in its right place or its right size."

Treating of the deductive process which the author recognises as virtually identified with induction in all successful investigation, the two being the "systole and diastole of logic," he argues that, to end in knowledge, pupils have to begin in faith. Thus:—"To determine not to proceed with arithmetic until you have demonstrated or have had demonstrated to you the validity of

* Journal of Science, 1879, p. 45.

all its primary assumptions, would be wilfully to foreclose the possibility of ever making way in the science of numbers."

A further contention, and one of very grave importance, is that "not only in beginning a course of physical inquiry, but in every stage of it we have to walk, by faith quite as much as by sight." In support of this declaration, a number of striking instances are given. "A philosophy restricted to one's own experience could be nothing better than a volume of travels by Simon Stylites." Even Darwin could not dispense with the observations and experiments of others, and was in consequence beholden to testimony.

But here comes an important consideration which the author has overlooked, and which, as far as we can call to mind, has not met elsewhere with due attention. Testimony in Science, and testimony, *e.g.*, in history, do not by any means stand upon the same footing. On the contrary, they differ in an important, if not the most important, respect. This will appear from the following illustration. We read, say in the *Comptes Rendus*, that Thalen has examined a newly discovered metal, and has found in its spectrum such and such characteristic lines. Why do we accept his testimony? Not merely because we know him as a skilful, thoroughly-competent spectroscopist, and as a man of unquestioned integrity who could, moreover, have no intelligible motive for falsifying or suppressing his observations. We receive his account of the spectrum because it is open to others to test and check his results. We know that others will have already done so, and we are well aware that Thalen himself has worked under the full expectation of such a revision. Hence he will have been equally on his guard against deceiving himself or attempting to deceive others.

With testimony in history this is not the case. We cannot send anyone up the stream of time to verify the statements of old chroniclers, or of monumental inscriptions and hieroglyphics. Testimony in Science is like a guide who, showing us round some palace, should throw open door after door, and whilst telling us the contents of each room, should give us the opportunity to examine for ourselves.

Historical testimony, on the other hand, is like a guide who, whilst describing the various rooms, should bid us take his word, as the keys were lost.

One postulate which must be granted, in faith as a preliminary to our scientific studies, the author does not bring into full relief. We refer to the necessity of assuming, without the possibility of ever proving, that the impressions made upon our senses are accurate or at least comparable pictures of an objective world.

We cannot, however, follow Mr. Griffith any further. Dissenting as we must from the Teleology which makes so prominent a figure in his fifth and sixth chapters, and which we believe merely strengthens the hands of the school of thinkers which he is

opposing, we have not space to enter upon the prolonged criticism which it would require. The work as a whole has given us no small pleasure, and we recognise in the author, not merely a man of great and unusual learning, but what is of more importance a powerful and original thinker.

Proceedings of the Bristol Naturalists' Society. New Series. Vol. III. Part 3 (1881-2). Bristol: James Fawn and Son.

THIS issue contains a very considerable amount of sound valuable matter, and certainly indicates no falling off in the activity of the Society.

Mr. F. F. Tuckett and Dr. Beddoe, F.R.S., contribute a paper on the gradual diminution of the human head—a subject which has excited some little discussion in the press, but has been by no means thoroughly sifted. Mr. Tuckett's attention was first drawn to the subject by a remark made by a local hatter that during the last twenty-five years the size of hats had decreased by as much as half an inch in circumference. Messrs. Lincoln and Bennett, well known London hatters, state that the average size of hats sold by them has decreased from No. $7\frac{1}{8}$ in 1855 to No. $6\frac{1}{8}$ in 1880. Other evidence of a similar kind has been obtained from different hat manufacturers in England and Scotland, but it does not appear that enquiries have been made in Ireland, on the Continent, and in America. Nor does it appear whether the decline has only commenced within the last thirty years, or whether it can be traced to an earlier period.

Very little light has been thrown on the cause of the change. Dr. Beddoe suggests that there is "a certain degree of physical degeneration in the population of large towns." But decrease in the size of the head is not in all cases connected with diminution of stature, strength, or indeed intelligence. An instance has come under our notice where the size of the head has notably decreased in the male members of a family during three successive generations, though the stature has even more strikingly increased.

Mr. C. Richardson communicates an interesting geological paper on the age of the River Wye. Taking all the elements of the calculation at a minimum value, the smallest figure reached is 1,274,000 years.

Mr. H. S. Hele Shaw, C.E., discusses the methods of wind-measurement, a branch of meteorology of great importance, but as yet in a very imperfect state. As instances of the discrepant statements put forward by experts in the engineering phase of the question, thus Mr. Hawksley thinks that a pressure of 40 lbs. per square foot is unknown in this country. In America

engineers hold that no bridge has been exposed to more than 30 lbs. per square foot. Yet the Committee on the Tay Bridge disaster state that at Bidstone, near Liverpool, a pressure of 90 lbs. per square foot was recorded, and on another occasion 77 lbs., and at the Oxford Observatory the pressure in the storm of October 14 was found as high as 53 lbs. The probability is that the pressure of the wind in tempests varies, not merely from moment to moment, but in point of space from square foot to square foot. So that supposing the pressure upon a square foot is registered at 40 lbs., it does not follow that a building exposing a surface of 40 feet by 30 feet would have to bear at any moment a pressure of 48,000 lbs.

Mr. S. H. Swayne gives a few remarks on the carnivorous "owl-parrot" of New Zealand, *Nestor notabilis*. The writer suggests that if this species continues to exist and maintain its carnivorous propensities, it may possibly develope into a decidedly raptorial bird. We fear that this interesting experiment is not likely to be tried.

Professor Ramsay communicates a most interesting memoir on the sense of smell. After contending that four of the senses —six in number if we include, as we fairly ought, the recognition of heat—are in all probability mediated by vibration, he asks whether smells are excited by liquids, solids, or gases? The two former states of matter being excluded experimentally, gases and vapours only remain. He considers that the property of smell is confined to some elements only. Substances which have no smell, or which are merely irritating when inhaled, have all low molecular weights. Among the carbon compounds, increase of molecular weight produces, to a certain point, smell. This the author exemplifies by several instances, such as the alcohols. Pure methylic alcohol he declares inodorous, "ethylic alcohol, when freed from ethers, has a faint smell, and the odour rapidly becomes more marked as we rise in the series until the limit of volatility is reached, and we arrive at solids with such of low vapour tension that they give off no appreciable amount of vapour at the ordinary temperature." Prussic acid, we learn, is not smelt by more than four persons out of every five.

A further conclusion is that smells are generic. Thus chlorine, bromine, and iodine, besides their specific differences in smell, have a something common to the whole group, which may be called a haloid smell. Very similarly sulphur, selenium, and tellurium, in combination with hydrogen have a generic odour. In like manner various generic groups of smells may be traced among the carbon compounds.

The tendency of a rise in the series is to make the smell "heavier," less etherial, and more characteristic.

As a theory of the sense of smell, which is hitherto a desideratum, Prof. Ramsay suggests tentatively the following. "There

is a probability that our sense of smell is excited by vibrations of a lower period than those which give rise to the sensations of light and heat. These vibrations are conveyed by gaseous molecules to the surface net work of nerves in the nasal cavity. The difference of smells is caused by the rate and by the nature of such vibrations, just as differences in tone of musical sounds depend on the rate and on the nature of the vibration ; the nature being influenced by the number and pitch of the harmonics." To produce the sensation of smell a substance must have at least fifteen times the molecular weight of hydrogen.

The author considers that we must look to radiant heat for indications of harmonics of the fundamental vibrations which are according to his theory the cause of smell. Prof. Tyndall has shown that odours have the power of absorbing heat rays. The author considers that smell is more analogous to sound than to light, since in a mixture of smells it is possible to recognise each ingredient.

This paper is in our opinion deserving of most careful study, and may, or rather should, lead to prolonged experimental research. The chief difficulty in the way is that this sense affords far more anomalies and idiosyncracies than the senses of sight and hearing. Numbers of persons declare that they can smell nothing where to others a very distinct odour is perceptible.

The same author read at one of the meetings a memoir on "The Connection between Chemical Constitution and Physiological Action." Unfortunately it has not found a place in the proceedings, and we can merely summarise the author's conclusions from the "Reports of Meetings." He finds that hydrocarbons have little, if any, action on the animal organism. 2. The introduction of oxygen, when the resulting substance does not produce local irritation, acts on the organism. A low molecular weight coincides with a transitory effect; and as it increases the effects become more marked. 3. Compounds containing chlorine all affect the organism. Its specific action consists in causing irregularity of the heart's pulsations and in lowering the blood pressure. The peculiar action of the carbon and hydrogen in compounds containing chlorine is to produce irritation in the nerve-centres and in bodies of high molecular weight to cause spasms. 4. Nitrogen shows great versatility in the part it plays. Many bodies containing it, such as the natural alkaloids, have their poisonous action greatly lessened by the addition of methyl and similar radicals, while others become much more active by their addition. 5. Increase of molecular weight corresponds with increased toxical action. 6. Polymeric bodies have a different, and in some cases a much more energetic, action than the compounds from which they are built up."

It is not stated in what manner the compounds in question have been introduced into the animal system—a point of some

moment in comparing Prof. Ramsay's results with those of other experimentalists, nor do we learn what animal species were operated upon.

In addition the number before us contains a memoir by Prof. Sylvanus Thompson, on "Volta-electric Inversion;" one on "Our Knowledge of the Nature of Chemical Phenomena," by W. A. Shenstone; on "Brownian or Pedetic Motion," by Professor Ramsay; on "Colliery Explosions," by E. Withered; and on the "Smoke Abatement Exhibition," by Professor J. F. Main.

We think our readers will agree with us that the Bristol Naturalists' Society deserves well of all friends of Science, and is setting an excellent example to similar societies elsewhere.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

BURROWING BEETLES.

To the Editor of the Journal of Science.

SIR,—Your able contributor Mr. G. H. Kinahan, in his interesting paper on the formation of vegetable soil, as inserted in your July issue, makes due and true notice of the services of certain beetles in deepening the soil. The blue species which he says are locally called by the singular name of "bumbly bees" are without doubt some kind of *Geotrupes*, and very serviceable they are in loosening the soil, carrying down and covering up the excreta of horses, cows, &c., and bringing up heaps of clay, &c. I should think that in pasture-lands they must be more efficient agents than earth-worms. The larvæ of the "cockchaffer" (*Melolontha maialis*) penetrate into the earth to the depth of 2 feet or more, but I have never known them bring up any appreciable quantity of soil. The female, when about to lay her eggs, generally selects soils already well loosened by cultivation, as she has not the robust legs of the *Geotrupes*.—I am, &c.,

AN ESSEX COLEOPTERIST.

THE ADVANCEMENT OF MEDICINE BY RESEARCH.

To the Editor of the Journal of Science.

SIR,—Is the "Association for the Advancement of Medicine by Research, which was inaugurated by such a number of illustrious scientific men, medical and non-medical, a *bona fide* working

body, or was the meeting on March 28th a mere demonstration? [We are here compelled to cut out a political allusion in which our correspondent has indulged.] I do not see that it has done anything at all in proportion to the expectations entertained and the promises held out. Prof. Owen's excellent little work on Physiological Experimentation, which seems to be issued under its sanction, might have appeared equally well without it.—I am, &c.,

A GRADUATE.

NOTES.

H. A. Brons (" American Naturalist ") gives some most valuable notes on the habits of some of the serpents of the Western States. The garter snake (*Eutœnia radix*) captures great numbers of fishes which have been left in shallow water when the floods have receded. In Texas and Mexico it is not uncommon to catch the venomous " cotton mouth " (*Ancistrodon piscivorus*) whilst fishing with hook and line. The prairie dog (*Cynomys ludovicianus*), the rattle snake (*Crotalus confluentus*), and the burrowing owl, though they dwell together, do not form a happy family. Both the snakes and the owls destroy the young dogs, and the snakes make free with the eggs of the owls. Several snakes, *Bascanium constrictor* and others, swallow the eggs of the domestic fowl unbroken. The blowing adder (*Heterodon simus*) seizes the hind foot of the box turtle (*Cistudo ornata*), and sucks the blood from it. The author caught a snake in the act. The foot of the turtle was bleached, and blood was still flowing; two toes were missing, and had been digested from the foot. The notion that snakes only attack creatures which they can swallow must be abandoned.

An eminent medical contemporary writes :—" Our profession ought to feel flattered by its exclusion from the honour (?) of baronetcy. A Mr. Lawes—an estimable gentleman who deals in manure—has just been decorated by Her Majesty. Probably the next " Gazette " will contain the names of the proprietors of Thorley's cattle food—hop bitters—and of the immortal 'Cockle.' Surely Col. Burnaby might be induced to do something with the Premier for his *protégé*." But the Mr. Lawes in question has fairly earned national honours by the Rothamsted experiments in agricultural chemistry, which but for him would never have been carried out.

We regret to announce the death of Prof. Emilio Cornalia, of Milan, an eminent entomologist, and author of the best-known work on the anatomy and physiology of *Bombyx Mori*.

Prof. J. Hutchinson, in a lecture delivered at the Royal College of Surgeons, maintains the persistency of a considerable Roman element in the population of England. (A day's walk in the " Back-bone of England," *e.g.*, to the west of Halifax, will reveal to the ethnologist abundant specimens of the typical Roman features and complexion. In view of such facts we may calmly ignore the assertions of modern historians.)

M. C. Richet ("Comptes Rendus") has made a series of experiments to determine the proportional "toxic power" of the alkaline chlorides. The animals operated upon were guinea-pigs, and the chlorides were introduced by subcutaneous injection. According to his results there is no relation between the atomic weight and the physiological activity. Lithium, which has the lowest atomic weight, is poisonous in the smallest dose. Rubidium and cæsium, whose atomic weights are highest, are more inoffensive than potassium and sodium.

Prof. E. de Cyon ("Ciel et Terre"), having studied the action of high atmospheric pressures upon animals, concludes that oxygen is not a special poison for the organism; animals die at such pressures because the carbonic acid (the chief excitant of the vaso-motor and respiratory centres) diminishes sensibly, and circulation and respiration are arrested.

On the West coast of Africa teetotallers die first, hard-drinking men second, whilst the temperate live longest.

Dr. G. Johnson has, in his recent "Harveian Oration," effectually disposed of the pretensions of Cesalpino to be regarded as the discoverer of the circulation of the blood—pretensions advanced chiefly by Italians and Anti-Vivisectionists. The latter at one time sought to show that Harvey had not been led or assisted in his great discovery by experiments upon living animals. When this ground became untenable they turned round, and denied that Harvey had made any discovery at all!

Dr. Niemeyer's "Athem-gymnastik," or breath-gymnastics, is calculated to meet a real evil. Brain-workers undoubtedly fall into the habit of imperfect breathing.

Mr. Wilkie Collins is coming forward as an enemy of Science. He is about to attack experimental physiology by tracing the effect of the habitual practice of "cruelty" on human character.

Mr. J. A. Gotch has lately read before the Architectural Association an exceedingly able paper on "Art in Dress." His views being thoroughly rational will be practically ignored by the British public.

For the benefit of those who still confound Evolutionism with Positivism, we quote the following dictum of M. Charles Robin, the positivist leader:—"Darwinism is a fiction, a poetical accumulation of probabilities without proofs, and of seductive explanations without demonstrations.

M. Moigno ("Les Mondes") writes:—"In Germany they only accept with great difficulty discoveries which come from abroad, especially, perhaps, those coming from France!" We have always found Germany more prompt to recognise foreign merit than France. Witness the case of Darwin.

M. G. Hayem ("Comptes Rendus") traces the spontaneous cessation of the escape of blood from an injured vessel to the hæmatoblasts, which, on coming in contact with the edges of the wound, adhere to it, and gradually accumulate till they block up the aperture.

Prof. V. Graber ("Archiv. für Mikros. Anatomie) has made a series of experiments on the hearing of insects. He found a common cockroach, two beetles (species ?), a *Chrysopa*, and a house-fly very sensitive to sound, whilst the larva of the cock-chafer and several species of ants gave no marks of recognising the strongest sounds and noises. Water-bugs of the genus *Corixa* were much excited by sound, whilst mechanical agitation of the water did not seem to disturb them.

L. O. Howard ("American Naturalist") finds that *Metapodius femoratus*, a large field-bug, sucks the juices of the caterpillar of *Leucania unipuncta*, the "Northern army worm," and leaves the exhausted and shrivelled corpse suspended over a forked branch of May-weed (*Maruta cotula*). "The whole long line of May-weeds was garnished with the empty skins of *Leucania* larvæ, each carefully hung over the fork of a branch."

Mr. Chichester Ward ("Report on Botany of Polar Regions") notes that in the low grounds of Southern Greenland true blue flowers, such as *Veronica alpina*, are rarely met with, whilst true reds never occur.

W. Irvine Fortescue ("Scottish Naturalist"), in a paper on the flowering plants and ferns of the Orkneys, states that *Fuchsia magellanica* thrives in the open air in Orkney, and that *Phormium tenax* flourishes in North Ronaldshay.

The "American Naturalist" complains, with justice, of an additional tax on knowledge with which the student in the United States has to contend. Books coming through the foreign posts are charged with an import duty of 25 per cent if the value exceeds a dollar. A number of tedious formalities are also required, and there is of course the risk of the book disappearing altogether.

S. A. Forbes ("American Naturalist") mentions that "if there were no Entomostraca for young fishes to eat, there would be very few fishes indeed to prey upon Mollusca, and that class would flourish almost without restraint. On the other hand, if there were no Mollusca for the support of adult fishes, Entomostraca would be relieved from a considerable part of the drain upon their numbers, and would multiply accordingly.

M. J. Rossbach ("Med. Central-Blatt.") has observed that whilst the blood of a healthy rabbit is free from moving organisms, immediately after the injection into a vein of 0·05 to 0·1 grm. of the vegetable ferment papayotine, the blood swarmed with true

bacteria. This fact supports the opinion that in true infections, along with the inoculated organic germs, a simultaneously present chemical poison is not without importance. Rosenberger has observed a similar result on the injection of septic matter which had been previously freed from bacteria by boiling.

Lord Talbot de Malahide, in a paper read before the Anthropological Institute, treated on the longevity of the Ancient Romans in North Africa. The author gave several instances of epitaphs and inscriptions on tombs of persons whose age had exceeded 100 years; in some cases an age of 120, 130, and even 140 years had been attained. These facts do not agree with certain current notions.

According to the experiments of Herr W. Detmer ("Landwithschaftliche Jahrbücher") vegetable cells are not able to decompose nitrous oxide, but are injured by its presence. In hydrogen gas no growth is possible, and the plants are injured. In pure carbonic acid seeds do not germinate, and etiolated plants do not become green. Vapours of chloroform injure growth, but the process of respiration is not brought to a standstill.

We regret to learn that the proposed statue of Darwin is to be erected at South Kensington. Surely some more central locality could have been found.

M. l'Abbé Moigno ("Les Mondes") notices, in a very laudatory manner, an Anti-Evolutionist treatise entitled "La Lutte pour l'Existence."

M. Bouquet de la Grye ("Annales de Chimie") finds, in accordance with Gay-Lussac and Humboldt, that in the region of both tropics the ocean contains more saline matter than at the Equator and beyond the Tropics.

It is stated that the common house-fly is capable of emitting sounds perfectly distinct from the buzzing of its wings, and which may possibly serve these pests as a means of mutual communication.

The Committee appointed by the Royal Microscopical Society to consider the advisability of adopting standard guages for eye-pieces and sub-stages, has, after consulting the principal microscope makers in London, come to the conclusion that two sizes should be recommended for eye-pieces, viz., No. 1 for large instruments, 1·35 inches, and No. 2 for smaller instruments, 0·92 inch, in both cases external diameter. These are selected from sizes at present in use, the No. 1 guage being that usual with most of the larger instruments constructed in England, whilst No. 2 is that adopted for small stands by many continental makers. As sub-stages are frequently of the same diameter in small instruments as in large ones, one standard size is deemed

sufficient, viz., 1·5 inches external diameter. The standard screw for objectives authorised many years ago by the Society has been almost universally adopted: it is to be hoped that for the future eye-pieces will only be made of the specified sizes; the inconvenience attending the parts of various instruments not being interchangeable is very great, and might in the course of a few years disappear if all new instruments were made to the standard sizes. With regard to sub-stage fittings, in most instances the 1·5 size has been found to be already in use.

M. J. Dembo ("Comptes Rendus") suggests the existence of a physiological relation between uterine excitability in various animal species and their fecundity.

M. Dastre, in a communication to the Academy of Sciences, shows that, if the normal rhythm of the heart is disturbed by inducing artificially a new contraction after each provoked systole, there follows a compensatory repose which re-establishes the rhythm.

The water of the Rio Grande holds in solution a trace of ruthenium.

Dr. Vogel ("Vienna Akad. der Wissenschaft") has demonstrated the presence of formic acid in the hairs of the larva of the processionary caterpillar.

Mr. H. Warner, of Rochester, New York, offers a prize of 200 dollars for any meteoric stone found in the United States and containing fossils revealing the presence of animals or of plants. A prize of 50 dollars is offered for a specimen of any areolite which has been seen falling in 1882.

According to an American journal, quoted by "Ciel et Terre" under the insufficient name of the "Chronicle," there is a relation between atmospheric humidity and the number of conflagrations, any cause affecting the one telling also upon the other.

M. Bouquet de la Grye (Academy of Sciences) contends that the temperature of the sea and its degree of saltness are factors to be taken into account in explaining the phenomena of the tides.

At the *Soirée* of the Society of Chemical Industry, held at Owens College, Mr. Fletcher, of Warrington, demonstrated the possibility of the combustion of gas without visible flame, the heat obtained from a ¼-inch gas-pipe being sufficient to fuse wrought-iron into drops.

We deeply regret to learn the untimely death of one of our most distinguished biological investigators, Prof. Balfour, of Cambridge.

Says a contemporary, "In France, Science is to some extent restricted by being confined within certain programmes, and a principle in order to be admitted has to be accepted by a clique of theorists, who generally show great reluctance to change old erroneous notions, and very often write in order to suppress what is not in accordance with their ideas." This is very true, but does it refer to France only?

According to Mr. H. Percival, if population goes on increasing at its present rate, in 214 years the world will have reached the frightful average of 700 inhabitants to the square mile.

Dr. J. F. Snyder ("Kansas Review of Science") declares that no traces of a "Stone Age" have been discovered in Africa.

M. Th. Anger, whilst Demonstrator of Anatomy at Clamart, witnessed the death of a female sloth and her six young ones, from tetanus. They had lived in a stable in which two horses had died of the same disease.

M. F. Carré ("Comptes Rendus") shows that the cost of refrigerating hams, &c., to the point necessary for the destruction of *Trichinæ* and other parasites, is rather less than 0·01 franc, or about one-tenth of a penny, per kilo.

Dr. G. Dickie, ex-Professor of Botany at the University of Aberdeen, died quite recently. He had occupied his chair honourably for seventeen years, but had been compelled to resign in 1877 in consequence of failing health.

J. P. Finley, of the U.S.A. Signal Service, contributes to the "Kansas Review of Science" a most valuable paper on tornadoes, in which he draws distinctions between cyclones, tornadoes, hurricanes, and whirlwinds.

The Albert Medal of the Society of Arts for this year has been assigned to M. Pasteur,—certainly not the least meritorious of those to whom this honour has been awarded.

The "Herald of Progress" speaks thus of scientific specialists:—"We have, mingling with men in scientific circles, divisional know-nothings beyond the structure of the petal of a flower, or of a beetle, or other trumpery auxiliary in the army of animated forces; who strut and act big in the high-heeled boot of a fellowship. Such five-feet-one-inch giants tell us prophecy is a myth, only practised by almanack makers and their compeers, because to such anti-rationalists and oblivionists hereafter is a myth—the one is impossible, because the other is."